

MONTHLY WEATHER REVIEW,

JANUARY, 1880.

(General Weather Service of the United States.)

U. S. WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to February 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 136 Signal Service stations and 16 Canadian stations, as telegraphed to this office; 157 monthly journals and 150 monthly means from the former, and 12 monthly means from the latter; reports from 27 Sunset stations; 234 monthly registers from Voluntary Observers; 43 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The general distribution of atmospheric pressure for the month, as reduced to sea-level, is shown by the isobaric lines upon Chart No. II. When compared with the January averages for the past eight years, the distribution of pressure for the present January is found to be very abnormal. From Lake Ontario to Virginia and thence northeastward to Maine it has been in excess, gradually increasing northeastwards to 0.13 inch on the east coast of New England; it is also slightly in excess (0.04) at Santa Fe and San Francisco. At all other stations there has been a deficiency; it averages about 0.04 on the South Atlantic coast and Lake Erie; 0.08 along the Gulf coast; 0.11 from Arkansas to the Lower Ohio valley and lakes Michigan and Superior, and in the Lower Missouri and Upper Mississippi valleys, 0.18; the largest deficiency, 0.21, occurs at La Crosse. At Virginia City, Montana, the deficiency is 0.13 and at Portland, Oregon, 0.11.

Local Barometric Ranges.—The total range of the reduced barometric readings have averaged about as follows: New England, 1.14 inch at Wood's Holl to 1.38 inch at Burlington; Middle States, 1.21 inch at New York to 0.93 inch at Norfolk; South Atlantic and Gulf States, 0.80 inch at Wilmington, 0.54 inch at Key West, 0.63 inch at New Orleans, 0.69 inch at Indianola, 0.97 inch at Shreveport; Mississippi and Ohio valleys and Lake region, from 0.99 inch at Memphis to 1.11 inch at Pittsburgh, 1.39 inch at Alpena and 1.33 inch at Duluth; Eastern Slope, 1.42 inch at Bismarck and 1.33 inch at Dodge City; Rocky Mountain Stations, 0.67 inch at Santa Fé to 1.19 inch at Virginia City; Plateau Districts, 1.00 inch at Salt Lake and Winnemucca, and 1.28 inch at Boise City; California, 0.61 inch at Los Angeles to 0.92 inch at Red Bluff.

Areas of High Barometer.—Thirteen high areas have appeared within the limits of the United States during the month. Nine of them appeared to develop over the extreme Northwest or Manitoba; one over the Mississippi valley, while the other three first appeared upon the Pacific coast. The latter are specially interesting on account of the low temperatures accompanying them.

This Paper is furnished by the Government of the United States, without charge to the Co-operating Observers acting with the Signal Office in the collection of Simultaneous Reports.

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No. I is a continuation of high area No. XI of the *December Review*; at 7 a. m. (Washington mean time,) it was central over the Upper Ohio valley, while the pressure was above the normal from the Southwest to Lake Michigan and thence to the Atlantic coast; north to east winds prevailed, with light rains in Texas, and foggy weather thence to Missouri and North Carolina; northwards, clear, frosty weather, followed by rising temperature during the day, and at night in the Ohio valley, light rains, as low area No. II progressed eastward over Canada. On the 2nd the barometer continued above the normal over the Southern States, with clear weather; while easterly to southerly winds and light rain continued from Texas to the Ohio valley.

No. II followed in rear of low area No. II. At 11 p. m. of the 1st the pressure had reached the normal in Dakota, and by 7 a. m. of the 2nd the highest pressures were over Minnesota; during the day the pressure increased as the area moved eastward over the Lake region and Canada, while it fell rapidly over the Northwest in advance of low area No. III. 3rd, moved eastward and at 11 p. m. was central over Nova Scotia; during the day the pressure increased over the South Atlantic States. 4th, the pressure over Canadian Maritime Provinces fell rapidly in advance of the low area before referred to, and the maximum pressure was transferred to the South Atlantic coast; clear or fair weather in the Southern States, but continued rains from the Southwest to the Lower Lakes in the barometric trough left by low area No. III, and which separated the present high area from the following.

No. III appeared over the Northwest during the night of the 3rd accompanied by clear, cool weather; on the 4th, moved rapidly eastward in rear of low area No. III to the lake region, and on the 5th thence to New England and Lower Canada. On the 6th it moved southeastward over Nova Scotia and Cape Breton; on the morning of which day the thermometer at Sydney, C. B., fell to -6° .

No. IV appeared over the Northwest during the night of the 5th and on the 6th and 7th moved rapidly eastward over Canada and New England to the Gulf of St. Lawrence, where the pressure remained high until the 9th, on the night of which day it fell rapidly in advance of low area No V.

No. V appeared over the Northwest during the 9th in rear of low No. V and at 11 p. m. was central in the Mississippi valley. 10th moved northeastward with increasing pressure and on the 11th was over Nova Scotia.

No. VI appeared on the Pacific coast on the 10th in rear of low area No. VI. 11th, extended eastward over the Plateau Districts, producing the minimum temperature of the month (27°) at Visalia, Cal. 12th, at 7 a. m. the highest pressure was at Salt Lake City, (0.34 in. above the normal,) with minimum temperature of the month (2°) at that station. 13th, moved to the Eastern slope and merged with high area No. VII. On this day the minimum temperature of the month occurred at Fort Gibson, 26° and Henrietta, 27° . Cautionary Signals for a "norther" ordered at Indianola and Galveston, were justified at former station by a north wind of 35 miles.

No. VII appeared over the Northwest during the 11th, in rear of low No. VI, and on the 12th, 13th and 14th moved slowly southeastward over the eastern half of the United States as an extensive area. On the two latter days it produced the minimum temperatures of the month in the Ohio valley and Atlantic States.

No. VIII appeared over the Northwest during the 14th in rear of low No. VIII and during the 15th moved eastward to the Atlantic States, where it remained until the 17th, when it disappeared to the eastward.

No. IX—The pressure, which had continued comparatively high on the Pacific coast since the passage of high No. VI, rose decidedly during the 14th over Oregon, and continued high over this region until the 16th, when this area was transferred to the Plateau Districts, but with diminishing pressure. During the 17th it was apparently transferred to the Southwest and on the 18th covered the Gulf States.

No X appeared over Manitoba on the night of the 18th, and during the 19th extended eastward over Canada, as low area No. XI began its eastward movement. On the 20th it was apparently to the northward of the St. Lawrence valley.

No. XI slowly developed over the Mississippi valley during the 23rd as low area No. XII moved over Canada and Maine. 24th, it covered the country east of the Mississippi, and on the 25th was transferred to the Atlantic States. 26th and 27th, it moved northeastward over New England and Nova Scotia.

No. XII appeared over Manitoba on the 27th, while low areas Nos. XVII and XVI covered, respectively, the Plateau districts and Mississippi valley. 28th, it extended south and eastward in rear of low area No. XVI and on the 29th moved eastward to the Atlantic States, where it remained until the evening of the 30th, when it gave way in advance of low area No XVII.

No. XIII appeared over Oregon and Washington Ty. on the 29th, as low area No. XVII moved eastward over the Rocky Mountains; increasing in pressure, but extending southeastward to the Mississippi valley, it, however, remained central on the Pacific coast to the end of the month. Cautionary Off-shore Signals ordered, for a "norther" on the coast of Texas were justified by Indianola, N- 42, and Galveston, N. 26.

Areas of Low Barometer.—During the month eighteen areas of low barometer appeared within the limits of observation, nine of which Nos. II, III, IV, V, VI, VIII, IX, XI, XIV, first appeared on the Pacific coast. Four Nos. VII, X, XVI and XVII, were formed, as secondary areas in the depressions left by areas, Nos. VI, IX and XIV. Three, Nos. XII, XIII and XVIII first appeared over, or to the north of Montana, while one No. XV first appeared over the eastern portion of the Gulf of Mexico. 15

No. I is a continuation of low area No. XX of the *December Review*; its centre passed eastward to the south of Nova Scotia early on the morning of the 18th, accompanied by northerly winds and heavy snow along the coast of Nova Scotia and Cape Breton.

No. II is a continuation of No. XXI *December Review* and was central at 7 a. m., (Washington mean time,) of the 18th to the north of Montana, in which territory brisk to high south to west winds prevailed; during the day it moved rapidly eastward over Canada, accompanied by high westerly winds at the most northerly stations (Pembina, W. 41; Marquette, SW. 34; Escanaba, SW. 32; Saugeen, SW. 33); light rain fell in the Ohio valley and Lower Lake region. 2nd, it passed eastward with its centre to the north of the valley and Gulf of St. Lawrence; at Father Point the wind reached a velocity of NW. 43, at 11 p. m.; light rain fell at Chatham and Sydney. Cautionary Signals ordered on the morning of the 1st at Milwaukee and Grand Haven, at midnight of the 1st from Cape May to Sandy Hook, on the morning of the 2nd from New York to Eastport were justified, except at Eastport, Maine, by the following velocities:—Milwaukee, S. 28; Cape May, SW. 29; Newport, SW. 28; Thatcher's Island, SW. 36. They were ordered late for the New England coast.

No. III appeared on the Pacific coast during the 2nd. At New Westminster, B. C., from 1 to 5 a. m. (local time) a heavy SE. gale prevailed with fierce gusts of wind and rain; wind continued from the SW. throughout the day, at 8 p. m. snow squalls began, and by 9 a. m. of the 3rd the ground was covered with frozen snow to a depth of 1½ inch. Fresh southerly winds and rain throughout the day at Olympia and Portland, O., and occasional light rains thence southward to San Francisco. At night the winds increased to brisk, with light snow at stations in northern Idaho and western Montana. 3rd, moved rapidly eastward over British America, apparently unattended by precipitation near its centre, but preceded in the Upper Mississippi valley and Lake region by foggy and rainy weather, and in Ontario by sleet and snow. 4th, it moved northeastward to Labrador and was followed over the Northwest and Lake region by high area No. III. Cautionary Signals, ordered on the morning of the 3rd at Milwaukee and Grand Haven, and at noon of the 3rd from Cape May to Sandy Hook, were not justified.

No. IV appeared on the Pacific coast on the 3rd, with its centre, like that of the preceding area, to the north of our stations. At New Westminster the barometer at 9 and 11:56 a. m., read 29.75 and 29.76, respectively, after which it fell and at 9 p. m., read 29.60 with heavy rain. "At 11 p. m., a tremendous heavy gale set in from SE., with heavy rain and fierce gusts, which continued, with intervals of dead calm, until 8 a. m. of the 4th. The average velocity of the wind was over 35 miles an hour, but as there were calms and lulls it is estimated that some of the gusts attained a velocity of 60 miles." The observer also states "that there is no doubt this is the heaviest gale we have had here for four years * * the rain came down in sheets * * in fact it was more like a November gale in England than any I have seen since I came here, (1863.)" The rain continued until 8 a. m. of the 4th, at which hour, however, only 0.98 in. was measured, and was followed by flurries of snow; the pressure remained low, the barometer reading 29.42 and 29.43 at 4 and 12 a. m., respectively, after which it rose and by noon of the 5th had regained 29.75. Southerly winds and rain prevailed in Washington, Ty. and Oregon, changing to snow at Olympia. During the night of the 4th and morning of the 5th, high southerly winds and gales, with light drifting snow prevailed in western Montana, and during the afternoon of the latter date, the depression passed rapidly eastward over Manitoba, preceded by rising temperature, fog and light rain, in the Upper Lake Region; thunder and lightning was reported at 11 p. m. at Marquette, and heavy rains fell in the Lower Mississippi valley. On the 6th it probably moved northeastwards to Labrador, as high area No. III. passed to the south of Nova Scotia, and high area No. IV advanced to the Lake region. Cautionary Signals were not ordered in advance of this area.

No. V appeared off the Pacific coast during the evening of the 5th; on the morning of the 6th, its centre was probably over the ocean, some distance to the west of Olympia and moving southwards. The winds at Victoria, New Westminster and Olympia, which on the 5th were southerly or easterly, changed on the 6th to NE. and N., with heavy snow. After a temporary rise of pressure, during the morning of the 6th, at Portland and Olympia the barometer fell rapidly, and at 4 a. m. of the 7th had reached the lowest (29.13 or 0.82 inches below the normal) at Olympia. This was probably near the storm-vortex as the air was calm at the station; at Portland and Umatilla, brisk to high SW. winds prevailed; while to the north and NE. winds prevailed, with very heavy snow. At Pt. Townsend the snow was 3 feet deep; Seattle, 4 feet; Victoria 29 inches and in surrounding country 4 feet; Yale, 10 feet and at New Westminster, 2 feet. Hundreds of barns were demolished by the weight of snow and communication much interrupted. 7th and 8th, the storm moved rapidly eastward, pursuing a course about five degrees south of the two preceding areas, and attended by brisk to high winds and occasional light snow. 9th, at 7 a. m., (Washington time,) it was central in the Upper Mississippi valley and during the day passed over Lakes Michigan and Huron as quite a severe storm; at 11 p. m. it was central near Parry Sound. 10th, it moved down the St. Lawrence valley, accompanied by high winds

and at 3 p. m., was central over the Gulf. Cautionary Signals ordered at Milwaukee and Grand Haven and along the Atlantic coast from Hatteras to New York on the morning of the 9th, and from Wood's Holl to Eastport, during the afternoon of the 9th, were justified at the lake stations and along the New England coast. The following maximum velocities were recorded:—Portland, Or., S. 33; Umatilla SW. 38; Boise, SE. 28; Cheyenne, W. 36; Omaha, NW. 39; Milwaukee W. 42; Eastport, NE. 29.

No. VI appeared on the coast of Oregon early on the morning of the 9th. This was the last, and by far the most severe of a series of five storms, (Nos. II, III, IV, V and VI,) which appeared in rapid succession on the Pacific coast, and subsequently moved eastward across the continent, from December 31st to January 11th. It was encountered early on the morning of the 9th, off the coast of Oregon, by Steamers "*Oregon*" and "*Victoria*" of the Pacific Mail Steam Ship Company. The following is an extract from the log of the "*Oregon*." "Left Astoria for San Francisco on the morning of the 8th, barometer 30.00 and falling; midnight, barometer falling rapidly, wind S. strong gale, squally; sea heavy swell; 9th, 4 a. m., SSE strong gale; 6 a. m., off the Umpqua river, SE hurricane, tremendous sea, barometer 28.20, no change to 10 a. m.; when shipped very heavy sea, sweeping away portion of bulwarks—barometer began rising, wind SE; noon, wind veered to SW. light; 2 p. m. to midnight, SW. squalls with rain, sleet and snow; midnight, wind veered to NW." The Steamer "*Victoria*" which was 45 or 50 miles distant to the northwest of the "*Oregon*" experienced NW. winds, while the *Oregon* had SE. winds, the barometer reading the same on both vessels. The *J. G. Wall* lost bulwarks and rails &c., in very heavy southerly gale on the 8th, (probably 9th) while off Umpqua. Schooner *Emma Utter*, was blown on the rocks above Empire City early on the morning of the 9th. At Empire City a heavy southerly gale prevailed, during which buildings were blown down, wharves washed away and several lighters sunk; the gale was the most severe ever experienced at Coos Bay. In Clatsop county, at the mouth of the Cumberland river, the storm, during Thursday night, (Friday morning) was exceedingly severe; the tide rising six inches higher than before noted; "on Friday the wind suddenly changed to west and, as the trees were heavily laden with snow, struck the forest with terrible effect, loss estimated at thousands of dollars." At Westport, Clatsop county, at 2 p. m., of the 9th, "a storm of snow and wind set in and continued for 2 hours with great fury, uprooting trees &c.; in the neighborhood much damage was done to buildings, bridges, &c." In Washington county, a number of barns and houses were were blown down and great destruction done to fences and trees—various roads leading from Portland were completely blocked by fallen timber—the damage in northern part of the county is estimated at \$20,000. In the Willamette valley much damage was done to timber, &c.; at Salem, buildings were damaged during "a severe wind and rain storm, which was followed by a heavy fall of snow." During the day it passed rapidly eastward over Oregon, Washington Territory and Idaho to western Montana, doing much damage throughout the Cumberland valley. The lowest barometer readings occurred at Roseburg between 8 and 12 a. m.; Portland, at 1:20 p. m., at which station an observation was made every 15 minutes from 10 a. m. to 4 p. m., the pressure remaining below 29.00 inches from 10 a. m. to 3 p. m.; Olympia, at 2 p. m.; New Westminster, B. C., 3 p. m.; at Umatilla the pressure, at 2 p. m., was falling and the lowest probably occurred about 6 p. m.; Boise City, Idaho and Virginia City, Montana, at 9 p. m. At Roseburg the wind continued throughout from S. and SW., and at 4 p. m. the rain changed to snow. At Portland the wind was SE. fresh, from 3:57 to 11:30 a. m., when it suddenly increased to a velocity of 40 miles and veered to S.; at 11:45 it increased to 45 miles, and at 1:45 p. m., to 50 miles, though it is estimated that there were occasional gusts of 70 miles; the maximum registered velocity was 53 miles per hour from 1:50 p. m. to 2:05 p. m., this being the highest on record at the station and "without a parallel within the recollection of the early settlers of this State"; at 2:45 p. m. it veered to W. and at 5:30 backed to SW. Many buildings were demolished in the city, the total loss being estimated at about sixty thousand dollars—one person was killed; "the trees, on the hills in the vicinity of Portland, fell toward the NW. during the early part of the storm, and to the NE. and E. during the latter part." At Olympia the wind was S. from 3:56 a. m. to 7 a. m., when it backed to NE with heavy snow. At noon and 2 p. m. it was N., still snowing, but at 7:56 p. m. had backed to SW., with clear weather. At La Centre, Clark county, a school building was crushed by a falling tree and two children killed. At Vancouver the barracks were damaged to the amount of \$2,000. Steamer *Idaho* left Cascade at noon for Portland, but about 1:30 p. m. met the "terrible" storm and had to return; vessels were driven ashore at Cascade and Grate's Point; at Dallas a heavy wind prevailed, but no damage was done. An observer at Goldendale, Kilikitat county, to the east of the Cascade range, says "the storm from the Willamette, Umpqua and Rogue valleys, came over the Cascade Mountains and down upon us with great fury. The snow had disappeared on the evening of the 8th, but on the morning of the 9th came again from the NE. until noon, when it ceased and a warm breeze set in from the S., which continued to 3 p. m., when a SW. gale commenced and lasted until late in the evening." At Umatilla a velocity of 80 miles was registered; during the morning a light wind blew from the E., and at noon backed to SE, after which it increased rapidly and at 2 p. m. was SW. 60 miles; at 8 p. m., it was W. 32; many buildings were blown down. In Columbia county, at Dayton, the wind, which was SE. at noon, commenced to blow from the SW. about 1 p. m., and continued steady until 6 p. m., when it increased to a hurricane, which lasted until 7; at 8 p. m. the barometer began to rise and the wind fell somewhat, but continued to blow with considerable force from the west throughout the night; buildings were damaged, and in the vicinity a house was literally blown to pieces; at Waitsburg, "wind S., buildings were turned over;" at Pomeroy, church blown down, buildings damaged and on the mountains in the vicinity, forest trees were blown down; at Patoka City "the storm of Friday night was the severest

ever known, damaging barns, &c." At Lewistown, Idaho, at 8.20 p. m. the wind attained a velocity of W. 35 miles. At Boise City the wind was SE. from 4.24 a. m. to 2 p. m.; SW. at 8.24 p. m., and W. at 9 p. m. At Virginia City, from the reports at present to hand, the wind continued in the SW. from noon of the 9th to noon of the 10th, after which it veered to W.; at this station it attained a velocity of 25 miles at 4.40 a. m., of the 10th. So far we have considered only the reports from places near the centre of the storm, but reports from British Columbia, California and Nevada show its influence to have extended to these regions. To the north the precipitation occurred as snow, and some very heavy falls are reported. At Victoria, V. I., snow commenced with a NE. wind at 4 p. m. of the 8th and continued to 3 p. m. of the 9th; at 4.17 p. m. the wind had changed to SW. and was blowing with a velocity of 50 miles per hour. At San Juan, this is reported as "the most severe season ever experienced, and on Friday the barometer fell lower than ever before noted, during which day a severe snow storm prevailed on the Sound, with a wind of 40 miles." At New Westminster, B. C., the barometer began to fall at 4 a. m., and continued falling rapidly until 3 p. m., when it reached 28.68 inches—the lowest reading ever recorded at the station; at 2 p. m. the wind, which had been NE. since the 6th, "began to shift to all quarters (light airs); 3.30 p. m., commenced snowing; 4 p. m., heavy gust of wind from the W., blowing the snow from the tops of the trees in clouds—on the hill tops the snow could be seen moving in dense white clouds to the SSE. of us, the clouds appeared to be revolving in a circle from the west to the south of station." The mail steamer from Victoria to New Westminster experienced northerly gales and tremendous snow storm in the Gulf of Georgia on the 9th. In California a shock of earthquake occurred about 5.45 a. m., and reports from Hollister, Gonzales and Santa Cruz will be found under the appropriate heading. Heavy SE. gales prevailed throughout the day, with rain, changing to S. W. in the evening. At Shasta trees were torn up; at Red Bluff the wind attained a velocity of SE. 60 miles about noon, and snow fell to the depth of about 12 inches on the surrounding mountains; at Modesta, in the San Joaquin valley, a SE. hard wind was blowing, and the weather "cold and bleak." A severe storm of snow and wind set in on the Sierra Nevada Range during the day, (9th) and continued all night (9th-10th) with unabated fury, blockading the main line of the Central Pacific R. R.; between Cisco and Emigrant Gap about 1000 feet of snow sheds were swept away by snow slides from the mountain slopes, and at 11 a. m. of the 10th, 800 feet of sheds were blown down between Cisco and Cascade. In northern Nevada the storm was severely felt and did considerable damage in the southern part of Humboldt county; at Winnemucca the wind reached a velocity of SW. 56 during the evening of the 9th. The accompanying table gives in 13 columns: 1st, the stations in Oregon, Washington Territory, British Columbia, Idaho and western Montana; 2nd, height of barometer cistern above sea-level; 3rd and 4th, time and height of highest reading preceding storm; 5th and 6th, time and height of lowest reading during storm; 7th, 8th and 9th, total fall, duration of fall and fall per hour; 10th to 13th, times of commencement of gale and highest velocity, and direction of wind and miles per hour registered during the highest velocity.

| | Altitude of barometer cistern above sea level. | BAROMETER REDUCED TO 32°. | | | | | | | | GALE. | | | |
|------------------------|--|---------------------------|-------------------|--------------------------|------------------|---------------|-----------------------------|----------------|-----------------|-----------------------------|------------|-----------------|--|
| | | Began falling— | | Lowest reading— | | Total fall. | Time of fall ^g . | Fall per hour. | Began— | Highest velocity. | | | |
| | | Time. | Height. | Time. | Height. | | | | | Time. | Direction. | Miles per hour. | |
| | | | | | | | | | | | | | |
| *Steamer "Oregon"..... | feet. | 5th, a.m. | inches. 30.00? | 9th, 6 a.m. to 10 a.m. | inches. 28.2† | inch. 1.80 | hours. 24 | inch. 0.075 | 5th, midnight. | 9th, 6 a.m. to 10 a.m. | SE | Hurricane. | |
| Roseburg..... | 537.0 | 8th, 9 p.m. | 29.35 | 9th, 7:55 and 11:55 a.m. | 28.61 | 0.74 | 12 | 0.062 | | 9th, noon. | SW | 26 | |
| Portland..... | 66.5 | 8th, 9 p.m. | 29.72 | 9th, 1:30 p.m. | 28.51 | 1.21 | 16½ | 0.073 | 9th, 11:30 a.m. | 9th, 1:50 p.m. to 2:05 p.m. | S | 53† | |
| Olympia..... | 36.0 | 8th, 9 p.m. | 29.62 | 9th, 2 p.m. | 28.43 | 1.14 | 17 | 0.067 | | | | | |
| N. Westminster..... | 33.0 | 9th, 4 a.m. | 29.58 | 9th, 3 p.m. | 28.68 | 0.90 | 11 | 0.082 | 9th, 4 p.m. | 9th, 4 p.m. | W | Heavy gusts. | |
| Umatilla..... | 461.0 | 8th, 9 p.m. | 29.49 | 9th, 2 p.m. | 28.46 | 1.03 | 17 | 0.061 | 9th, 1 p.m. | 9th, 6 to 7 pm | SW | 8† | |
| Boise City..... | 2,577.0 | 8th, 9 p.m. | 27.08 | 9th, 9 p.m. | 26.44 | 0.64 | 24 | 0.024 | | 9th, 2 p.m.? | SE | 32 | |
| Virginia City..... | 5,480.0† | 9th 8:40 a.m. | 28.91 | 9th, 9 p.m. | 28.33 | 0.58 | 12½ | 0.046 | | 10th 4:40 a.m. | SW | 25 | |

* From Astoria to off the Umpqua. † Gusts of 70 miles.

10th, it moved eastward over Montana and Dakota to Minnesota, attended by high winds and occasional snow, and on the 11th northeastward over the Lake region into Canada as quite a severe storm. Cautionary Signals ordered on the afternoon of the 10th at Milwaukee and Grand Haven, were justified by NW. 39 miles at the former, and S. 30 miles at the latter place. Sandusky reported SW. 36, and Saugeen SE. 44.

No. VII.—As low area No. VI moved northeastward over the Lake region on the 11th, a barometric trough stretched southwestward to Texas, in the southern extremity of which, the present area formed. On the morning of the 12th it was over northern Mississippi; barometer at Vicksburg, 30.16 or 0.06 below normal; during the day the lowest pressure was transferred to Virginia, and during the evening passed off the coast as high area No. VII advanced from the Northwest; northerly winds, with heavy rain or snow, prevailed throughout the day from Arkansas to Tennessee and the Ohio valley, and extended, by evening,

to the Middle States and New England. 13th, passed to the south of Nova Scotia, and at 11 p. m. was near Cape Breton; rain on the North Carolina coast, and snow thence to Maine, was followed by clearing and clear weather; heavy snow fell in Nova Scotia and Cape Breton. Cautionary Signals ordered from Cape Hatteras to Cape Henry on the afternoon of the 12th, and the morning of the 13th from Wood's Holl to Eastport, were fully justified by the following velocities:—Hatteras, NE. 40; Kittyhawk, NE. 60; Henry, NW. 60; Wood's Holl, NE. 28; Thatcher's Island, NE. 61, and Eastport, NE. 29.

No. VIII appeared on coast of British Columbia during the evening of the 12th; a SE. wind with heavy snow and rain, prevailing at Victoria, V. I. At New Westminster, B. C., snow began to fall early in the morning and continued until 4 p. m., when there were 12½ inches on the ground; it then commenced to rain, and continued throughout the night, with strong SE. wind, in gusts; at 9 p. m. the barometer had fallen to 29.36; rain or snow prevailed in Washington Territory and Oregon, and by 9 p. m. southerly winds (increasing to a gale at Fort Shaw) and light snow were reported from western Montana. 13th, in the morning, "the weather was bright and clear from the west at New Westminster, B. C., after 3 inches more snow during the night." During the day the area moved rapidly eastward to Manitoba; gales prevailed from Wyoming (Fort Fetterman, W. 40 to 59 miles; Cheyenne, W. 42) to Iowa and Minnesota (St. Paul, SE. 52., much damage to buildings); the only precipitation reported was very light rain or snow near the headwaters of the Missouri, at 4 a. m., and light snow (immeasurable) at Escanaba at 11 p. m. 14th, passed into Canada; light snow fell at Parry Sound. Cautionary Signals ordered, at 11 p. m., for Milwaukee and Grand Haven, were justified:—Milwaukee, SW. 26.

No. IX.—At 9 p. m. of the 13th, it commenced snowing at New Westminster, and at 3 a. m. of the 14th, a hard rain set in; at night a heavy SE. gale set in, with hard rain, and at 9 p. m. the pressure had fallen to 29.69. 15th, the wind veered to SSW., heavy rain, followed by clear weather and rising barometer. At 4 a. m. the centre of the present low area was north of Montana, in which State the wind was SW. brisk to high; at 3 p. m. it was central in the Red river of the North valley, with light snow, and at 11 p. m. had moved to the north of Lake Superior. The path of centre, being too far north, is not shown on Chart No. I.

No. X followed rapidly in rear of the preceding area, unattended by precipitation, and at 11 p. m. was central over Wisconsin, by which time, however, light rain or snow had commenced at Escanaba and Marquette. 17th, moved eastward over Ontario, and light rains or snows fell in the Lake region, St. Lawrence and Ohio valleys and Tennessee, and by night rains in the interior of the East Gulf and South Atlantic States. 18th, passed off the Atlantic coast, with light rains along the coast.

No. XI.—At New Westminster, B. C., 16th, "heavy rain, wind from all quarters, followed by warm fresh breeze, from S., river open;" at night SE. gale in gusts;" falling barometer, reaching 29.68 at 9 p. m. 17th, at 4 a. m. storm and gale in western Montana; area moved rapidly eastward during the day to Manitoba, unattended, so far as our reports show, by precipitation, except light snow at Fort Garry and Duluth. 18th, moved southward to Iowa, with clear weather from the centre southeastward and partly cloudy weather on the north and west sides of depression. 19th, remained almost stationary during the morning, with decreasing pressure, in the Lower Missouri valley; in the meantime the surrounding barometric gradient increased, and a strong northeasterly current set in from the Upper Lake region towards Missouri, having, at 3 p. m., an average temperature of 40°; (Milwaukee, 37°; La Crosse, 42°; and Davenport, 40°,) while the opposing southerly winds had a temperature of 52° at Springfield and 66° at Cairo, Ill.; at this hour rain was falling from St. Louis and Indianapolis on the south side to Chicago and Davenport on the north; by 11 p. m. the area had moved eastward and was central between St. Louis and Indianapolis; rain having extended eastward to western Pennsylvania. 20th and 21st, it moved eastnortheastward and at 3 p. m. of latter date was central over Nova Scotia. It was accompanied by heavy snow in the Lower Lake region, northern New York and New England and increasing in energy as it moved eastward, developed into quite a severe storm as it approached the coast of New England. South of the centre of path, as shown on chart I, warm southwesterly winds and clear or fair weather continued, except a light thunderstorm in the Middle States, the maximum temperatures of the month (68°) occurring at Lynchburg and Fort Whipple, Va. During the night of the 20th and early morning of the 21st it was central between Capes Cod and Sable as a very severe storm. Cautionary Signals ordered at Milwaukee and Grand Haven on the afternoon and along the Atlantic coast from Macon, N. C. to New York at midnight of the 19th, and thence to Eastport at midnight of the 20th, were justified, though late, for the coast of Maine. The following maximum velocities were registered: Milwaukee, NE., 26; Hatteras, SW., 36; Cape May, W., 37; Sandy Hook, NW., 42; Newport, W., 30; Thatcher's Island, E., 32; Portland, NE., 29, and Eastport, NE., 50.

No. XII appeared to the north of Montana on the 20th; gales were reported in western part of state, and light snow fell at Virginia City, Fort Buford and Pembina; during the night the depression was transferred rapidly southward to the Lower Missouri valley, with very light rain at Yankton and La Crosse. 21st, at 3 p. m. warm southerly winds prevailed, with light rains from the East Gulf States to southern Wisconsin and light snow northwards, while to the west of the Mississippi the wind had generally changed to NW.; during the evening a somewhat heavy thunderstorm moved from the central Mississippi valley over Kentucky and Tennessee. 22nd, moved northeastward to Ontario, with light rain turning to snow in the Lake region; light thunderstorms in the South Atlantic States, and rain or snow in the Middle States and

New England. 23rd, moved northeastward, followed by clear weather in New England. Cautionary Signals ordered on the afternoon at Milwaukee and Grand Haven, and at midnight of the 21st along the Atlantic coast from Macon to Sandy Hook; and on the morning and afternoon of the 22nd, thence to Eastport, were justified except at Macon and Lookout. Maximum velocities:—Milwaukee, NW. 30; Grand Haven, SE. 28; Cape Henry, NW. 32; Cape May, NW. E. 40; Sandy Hook, 36; Thatcher's Island, SE. 30, and Eastport, SE. 36. As the pressure increased during the morning of the 22nd over the Southwest, a severe "norther" set in on the coast of Texas, for which Cautionary Off-shore Signals had been ordered on the afternoon of the 21st. They were justified by Indianola, N. 40, and Galveston, N. 32.

No. XIII was to the north of Montana on the afternoon of the 22nd. Its track was too far north to appear on the Chart.

No. XIV appeared on the Pacific coast on the 24th, but reports north of Portland, Oregon, are not yet at hand. At that station, after four days of comparatively high pressure, the barometer fell and by noon reached 29.68, or 0.35 below the normal, wind S.; during the evening and night the barometer rose and the wind veered to NW., and at 9 p. m. the pressure was lowest at Boise (29.81, or 0.38 below the normal.) At this time the wind had increased to a gale in western Montana, and easterly winds, with threatening weather were prevailing at Humboldt and Battleford, British America. 25th, lowest pressures from Montana to Manitoba; the barometer at Virginia City rising from 29.10, or 0.57 below normal, to 29.37, or 0.29 below normal, and falling at Pembina from 29.52, or 0.56 below, to 29.23, or 0.83 below; light snows or rains fell along the Pacific coast, over the western Plateau and at Virginia City, Fort Custer, Deadwood, and Bismarck. The pressure remained low over the Plateau Districts, and the low area arising therefrom will be described as area No. XVII. 26th moved to the northward of Lake Superior. Cautionary Signals were ordered at Milwaukee and Grand Haven, and justified by S. 28 and S. 26 respectively.

No. XV appeared over the eastern Gulf on the 25th, and moved slowly northward during the day. 26th, moved northeastward over Florida, preceded by NE. winds and rainy weather in the East Gulf and South Atlantic States. 27th, moved slowly northeast off the South Atlantic coast. 28th disappeared or merged into the area of low pressure over the Lake region (No. XVI.) Cautionary Signals ordered on the 25th on the North Carolina coast; along the Gulf and Atlantic coasts from Port Eads to Wilmington on the morning of the 26th, and from Cape May to New York at midnight, were generally justified by winds attending either this area or area No. XVI; maximum velocities, Cedar Keys, S. 25; Savannah, NE. 32; Macon, NE. 35; Lookout, NE. 39.

No. XVI developed in the Southwest during the 26th as low area No. XIV moved into Canada. 27th moved rapidly northeastward to the Lake region unattended by precipitation or high winds. 28th passed rapidly to the Gulf of St. Lawrence.

No. XVII is the secondary depression that was left by area No. XIV over the Plateau Districts and remained there until the 28th. From the 26th to the 28th, stormy weather, with heavy snows, prevailed in California and the Southern Plateau district, of which interesting particulars will be found under the head of "snow." On the 29th it moved eastward in rear of high area No. XII, and preceded by easterly winds, rain or snow to the Lake region. 30th, moved over the Lake region with increasing energy, and on the 31st reached the Gulf of St. Lawrence. Cautionary Signals ordered up on the afternoon of the 29th at Milwaukee and Grand Haven, and along the Atlantic coast from Macon to Sandy Hook, and on the morning of the 30th thence to Eastport were justified. Maximum velocities: Milwaukee, W. 43; Lookout, NE. 39; Cape May, S. 36; Sandy Hook, SW. 48; Boston, W. 45, and Eastport, E. 32. At Boston the anemometer cups were blown away and the wind estimated at 60 miles.

No. XVIII passed eastward from Montana to Lake Superior on the 31st, accompanied by light snow.

INTERNATIONAL METEOROLOGY.

Three International Charts, Nos. IV, V and VI, accompany the present Review. No. IV indicates the probable course of the principal areas of low pressure over the North Atlantic ocean and neighboring waters and continents during the month of *December*, 1879; it is based upon observations made on board about 180 vessels, and which have been collected from various sources or received directly at this office up to February 5th, 1880. Nos. V and VI are charts for the month of *June*, 1878, and are based upon the International Simultaneous Observations, as described in the *Review* for July, 1879, supplemented by such other observations as have been considered specially applicable and trustworthy.

On chart No. IV the tracks of eight of the most prominent areas of low pressure, which, during a portion of their existence, were located over the North Atlantic ocean, are traced. In the following resume only that part of the ocean lying between the parallels of 35° and 55° will be referred to unless specially noted. The month opened with areas of low pressure over Europe, near the Azores, and to the north of Newfoundland. The first has already been noticed, as area No. XIV, chart IV, in the *December Review*; the second is a continuation of area No. XV, chart IV, of the same Review, while the third was probably a continuation of low area No. XVIII of the *November Review*. An extensive area of high pressure (over 30.40 inches or 772.1 m. m.) covered the ocean from 20° to 40° W and north of 45° N. The low area near the Azores, from which islands reports are not yet received, was probably central about 34° N 28° W, moving eastward. Steamer *Borussia* sailed from Coruna on November 26th, and had SE. winds which freshened to

a gale on November 30th; on December 1st, the wind suddenly chopped to NNW. with heavy cross sea, during which she sprung a leak and foundered on the 2nd, 350 miles to the southwest of Fayal, having on board about 225 persons. Steamer *Columbo* in 32° N. and 29° to 39° W. had a continuation of westerly gales from the 1st to the 5th. North of Azores northerly winds prevailed between 10° and 20° W.; easterly thence to 40° W.; southerly to 50° W., and northwesterly thence to the coast of the United States, where a second area of high pressure existed. 2nd and 3rd, the low area south of the Azores moved to the Bay of Biscay, accompanied by very heavy seas, and producing severe easterly gales and heavy snows over the British Isles; the high area north of the Azores and the low area north of Newfoundland disappeared, while the high area on the American coast moved northeastward, and on the morning of the 4th extended from the banks of Newfoundland to 35° W.; on the 3rd heavy easterly gales and high seas prevailed near the Bermudas. 5th and 6th, the low area moved rapidly eastward from the Bay of Biscay to the Black Sea, producing a slight rise of temperature to the south and east of its centre; with this exception, the cold period, which set in over western Europe during the first week of December, continued almost uninterrupted throughout the entire month. During the 5th, low area No. II, Chart I, December Review, passed eastward over Newfoundland and on the 6th was central about 55° N. 35° W., moving northeastward. 7th, low areas over mid-ocean and Canada; high areas over the east Atlantic and the Banks of Newfoundland; southerly to westerly gales in 55° N. 20° W.; northerly in 40° W. and southerly south of Nova Scotia. 8th, high area over the east Atlantic, extending over Europe, with very low temperatures; low area approached the coast of Norway inducing a temporary rise in temperature over northern Europe; southeast "hurricane" in 35° N. 23° W., and southeasterly winds thence northward to 50° N., along the western margin of high area; low area over Newfoundland. 9th, centre of high area was transferred to western Europe, over which region extremely low temperatures were recorded. At Paris, at 8 a. m. the thermometer registered -23.9° C. or -11° Fahr. Some hours earlier a temperature of -28° C. or -18.4° Fahr. was recorded on the surface of the snow. These are probably the lowest temperature readings ever recorded in this vicinity; during the winters of 1788-9, 1794-5 and 1871-2, -21.5° , -23.5° and -21.3° , respectively, were recorded, these being the lowest readings since 1700. In the British Isles the mean temperature for the week ending December 8th of seven stations in the Midland counties, when compared with the mean of the same week during thirteen previous years, shows a deficit of 19° Fahr.; minimum readings ranging from -11° Fahr. (-23.9° C.) to -2° (-18.9° C.) were registered at various places from the 2nd to the 7th. On the 9th a low area existed in the vicinity of the Azores; ship Peruvian was dismasted in a southeast hurricane and abandoned in about 43° N. 27° W.; high area over the western Atlantic. 10th and 11th, low area over mid-ocean, attended by southerly gales from 15° to 25° W. and northerly gales about 40° W.; high area over western Atlantic. 12th, southerly winds and rising temperature from British Isles to 30° W., northerly gales in 45° W.; a low area passed eastward north of Newfoundland. 13th, southerly winds and rain over the eastern Atlantic; high area over western Atlantic. 14th and 15th, high area moved eastward over the western Atlantic, followed during the latter day, by low area No. VIII, chart I, December Review. 16th to 20th, low area moved east-north-eastward from Newfoundland; southerly winds prevailed from the British Isles to 30° W., but thence westward westerly gales and high seas, accompanied from 17th to 20th by snow or hail squalls. 21st, the low area moved northeastward off the Irish and Scotch Coasts; steamer "Hibernian" at noon in 54° N. 18° W., had a west by north wind, force 7, barometer 29.68. From this day to the end of the month low pressures generally prevailed to the north of the 55th parallel, and during this period at least three distinct low areas can be traced from Newfoundland eastward. Severe westerly gales continued to prevail almost without intermission, across the Atlantic from Ireland to Newfoundland and extremely cold weather, with severe snow and "hail" squalls were experienced from 25° W. to the Banks of Newfoundland, while a decided rise in temperature took place over northwestern Europe. On the morning of the 21st a low area passed rapidly eastward over Newfoundland which was encountered by the "Hibernian" on the 22nd in 54° N. 23° W., lowest barometer 29.63 or 752.6, wind WSW. force 9. On the evening of the 23rd another low area passed over Newfoundland, which was encountered by the *Hibernia* on the 25th in 52° N., 33° W., and by the *Leipsig* in 50° N., 20° W., between 6 and 9 p. m. During the 27th it passed to the northward of the British Isles accompanied by very severe gales thence to the coast of Norway. On the 25th another low area passed eastward over Newfoundland; was experienced by the *Hibernian* on the 26th, in 51° N., 37° W., lowest barometer, 28.85 or 732.7, violent WSW. gale, (force 12,) with terrific squalls and high seas; by the *Leipsig*, from 8 to 11 p. m. in about 49° N., 23° W.; barometer, 29.60 or 751.8, remaining low all night and morning of the 27th; and by the *Rosend Castle* in 57° N. 19° W. On the 28th it passed rapidly eastward over the British Isles accompanied by hurricane winds; at 7 p. m. the "Tay-bridge disaster" occurred. 9th, high pressures prevailed over the Atlantic, with continued cold westerly gales and very high seas; low area, with high temperatures over northern Europe, while the high area over that continent moved southward to the Mediterranean accompanied by low temperatures. During the latter part of the day the pressure gave way over the western Atlantic and another low area covered Newfoundland on the 30th, which by the 31st had moved eastward to 35° W.

TEMPERATURE OF THE AIR.

The general distribution of the temperature of the air is shown by isothermal lines or figures upon chart No. II. On the right side of same chart is a table giving the average temperature, by districts, of

January for several years and for the present month. As might be expected from the abnormal distribution of pressure and consequent preponderance of southerly winds, it is found that the temperature for all districts, except those on the Pacific coast and thence to Utah, is abnormally high. For New England and the Middle States it is about 9° above normal, and for the Florida peninsula about 5°, but for all other districts east of the Rocky Mountains the excess ranges from 10° to 15.5°; the combined means of Cheyenne and Virginia City give an excess of 6°. In the valley of the Snake and Columbia rivers the excess is nearly 12° at Boise, 10° at Umatilla and 3° at Portland, Oregon. In California, and especially in the Sacramento valley, the temperature has been decidedly low.

Maximum Temperatures.—*Maine*: 54° at *Surry, 52° at Portland and 48° at Eastport. *New Hampshire*: 54° at *Contoocookville and 40° on Mt. Washington. *Vermont*: 48° at *Charlotte and *Lunenburg and 46° at Burlington. *Massachusetts*: 60° at Thatcher's Island, *Somerset and *Fall River and 56° at Springfield. *Rhode Island*: 61° at Newport. *Connecticut*: 65° at *Mystic and New London, and 59° at *Southington. *New York*: 66° at *Brookhaven, 64° at New York City, 57° at Buffalo, 53° at Oswego, 46° at Albany and 43° at *Plattsburg Barracks. *Pennsylvania*: 67° at Pittsburg, 63° at Philadelphia, 60° at *Catawissa and 51° at *Dyberry. *Delaware*: 64° at *Dover. *Maryland*: 68° at *Emmittsburg, 65° at Baltimore and 64° at *Cumberland. *District of Columbia*: 66° at Washington. *Virginia*: 75° at *Snowville, 73° at *Wytheville and 66° at Norfolk. *West Virginia*: 70° at Morgantown and 64° at *Helvetia. *North Carolina*: 80° at *Statesville, 70° at *Weldon and Charlotte and 67° at Cape Lookout. *South Carolina*: 77° at Charleston and 73° at *Aiken. *Georgia*: 87° at *Forsyth, 75° at Savannah and 71° at Atlanta. *Florida*: 86° at *Gulf Hammock, 77° at Jacksonville, 80° at Punta Rassa, 83° at Key West and 73° at Pensacola. *Alabama*: 74° at *Green Springs and Mobile and 75° at Montgomery. *Mississippi*: 74° at *Fayette and 77° at *Brookhaven and Vicksburg. *Louisiana*: 82° at *Okalooska and *Lake Charles and 75° at New Orleans. *Texas*: 92° at Decatur, 86° at Rio Grande, 81° at Fort Elliott, 79° at Corsicana and 75° at Galveston and Mason. *Ohio*: 67° at Cincinnati and *Ruggles, 64° at Columbus and 62° at Toledo. *Kentucky*: 70° at Louisville and 69° at Bowling Green. *Tennessee*: 78° at Austin and 72° at Ashwood, McMinnville, Nashville and Knoxville. *Arkansas*: 78° at Little Rock and 76° at *Mt. Ida. *Michigan*: 63° at *Thornville, 62° at *Lansing and *Kalamazoo, 57° at Grand Haven and Detroit, 52° at Alpena and 50° at Northport. *Indiana*: 74° at *Laconia, 67° at *New Harmony and 66° at Indianapolis. *Illinois*: 74° at *Anna, 70° at Cairo, 64° at Springfield and 61° at Chicago. *Missouri*: 72° at St. Louis, 67° at *Ashley and *Kansas City and 62° at *Corning. *Kansas*: 76° at *Fort Wallace, 74° at *Independence, 64° at Leavenworth and 61° at *Manhattan. *Wisconsin*: 58° at Madison, 53° at La Crosse, 44° at *Bloomfield and 42° at *Ashland. *Iowa*: 68° at *Vail, 63° at Des Moines and Keokuk, 62° at *Glenwood, and 55° at Dubuque. *Nebraska*: 76° at *Austin, 70° at North Platte and 62° at Omaha. *Indian Territory*: 75° at Fort Sill and 72° at Fort Gibson. *Minnesota*: 48° at St. Paul and 40° at Duluth. *Dakota*: 70° at Morriston, 67° at Yankton, 55° at Deadwood, 49° at Bismarck and 40° at Pembina. *Colorado*: 70° at *Fort Lyon, 63° at Denver, 51° at *Hermosa and 24° on Pikes Peak. *New Mexico*: 73° at La Mesilla, 67° at Socorro and 55° at Santa Fé. *Wyoming*: 63° at Cheyenne and 47° at Fort Fred. Steele. *Utah*: 47° at *Coalville and 45° at Salt Lake city. *Nevada*: 54° at Winnemucca. *Arizona*: 78° at Tucson, 76° at Yuma and 61° at Prescott. *Idaho*: 64° at Fort Hall and 57° at Boise City. *Montana*: 47° at Virginia City. *California*: 76° at Los Angeles, 71° at Red Bluff, 70° at Visalia and *Salinas City, 61° at Sacramento and 60° at San Francisco. *Oregon*: 63° at Umatilla, 57° at Portland and 56° at Roseburg.

Those marked with * are reported by Voluntary Observers or U. S. Army Post Surgeons.

Minimum Temperatures.—*Maine*: —15° at *Orono and 0° at Eastport. *New Hampshire*: —12° on Mt. Washington and —10° at *Dunbarton. *Vermont*: —12° at *Newport and 0° at Burlington. *Massachusetts*: —10° at *Billerica and 8° at Boston and Springfield. *Rhode Island*: 15° at Newport. *Connecticut*: 0.7° at *Southington and 10° at New Haven. *New York*: —6° at *Madison Barracks, —2° at Sidney Plains and *Plattsburg Barracks, 1° at Albany, 16° at Buffalo and 17° at New York City. *Pennsylvania*: —3° at *Dyberry, 3° at *Catawissa, 19° at Philadelphia and 20° at Pittsburg. *Delaware*: 20° at *Dover. *Maryland*: 3° at *Woodstock, 12° at *Cumberland, and 17° at Baltimore. *District of Columbia*: 14° at Washington. *Virginia*: 13° at *Mt. Solon, 23° at Lynchburg, 29° at *Walnut Grove and 31° at Cape Henry and Norfolk. *West Virginia*: 12° at Morgantown and 18° at *Helvetia. *North Carolina*: 15° at *Highlands, 25° at *Fayetteville and Wilmington, 26° at *Weldon, and 34° at Cape Lookout. *South Carolina*: 27° at *Aiken and 33° at Charleston. *Georgia*: 30° at Atlanta and *Gainesville, and 34° at Savannah and *Forsyth. *Florida*: 36° at *Gulf Hammock, 40° at Pensacola and *Houston, 45° at Jacksonville and 65° at Key West. *Alabama*: 30° at *Green Springs and 39° at Mobile. *Mississippi*: 32° at *Brookhaven and *Fayette, and 35° at Vicksburg. *Louisiana*: 28° at *Okalooska, 33° at Shreveport and 42° at New Orleans. *Texas*: 5° at Fort Elliott, 21° at Pilot Point, 28° at Mason, 32° at Denison, 38° at Rio Grande and 47° at Galveston. *Ohio*: 6° at *Westerville and *Urbana, 15° at Columbus, 18° at Cleveland and 25° at Cincinnati. *Kentucky*: 28° at Louisville and *Bowling Green. *Tennessee*: 25° at Knoxville and McMinnville, 26° at *Ashwood and 29° at Nashville, and Chattanooga. *Arkansas*: 20° at *Mt. Ida and 32° at Little Rock. *Michigan*: —2° at Marquette, 5° at Alpena, 9° at *Lansing and Kalamazoo, 12° Grand Haven, 13° at Northport, 16° at Port Huron and 19° at Detroit. *Indiana*: 15° at *Spiceland, 18° at Fort Wayne, 20° at Indianapolis and 26° at *New Harmony. *Illinois*: 10° at *Riley, *Belvidere and *Sterling, 20° at Chicago and 30° at Cairo. *Missouri*: 14° at *Corning, 18° at Kansas City and 23° at St. Louis. *Kansas*: —3° at *Ft. Wallace, 15° at *Holton, Manhattan, *Cedar

Vale and *Yates Center, and 20° Leavenworth. *Wisconsin*: —12° at *Ashland and *Neillsville, —6° at *La Crosse, and 6° at Madison. *Iowa*: —6° at *Cresco, —3° at *Ft. Dodge, 6° at *Glenwood, 10° at Des Moines and Dubuque, and 21° at Keokuk. *Nebraska*: —19° at *Ft. Sidney, —2° at *Genoa and North Platte, and 5° at Omaha. *Indian Territory*: 23° at Ft. Sill and 26° at Ft. Gibson. *Minnesota*: —19° at Duluth and —12° at St. Paul. *Dakota*: —35° at Ft. Buford, —32° at Pembina, —21° at Bismarck, —7° at Deadwood, —5° at *Morrison and —2° at Yankton. *Colorado*: —17° at Ft. Garland, —15° on Pike's Peak, —7° at *Ft. Lyon and —6° at Denver and *Hermosa. *New Mexico*: —2° at Santa Fé, 7° at Silver City and 20° La Mesilla. *Wyoming*: —25° at *Ft. Fred Steele and —11° at Cheyenne. *Utah*: —16° at *Coalville and 2° at Salt Lake City. *Nevada*: 0° at Winnemucca. *Arizona*: —17° at Prescott, 8° at Ft. Verde, and 30° at Yuma. *Idaho*: —11° at *Ft. Hall and 13° at Boise City. *Montana*: —18° at Virginia City. *California*: 25° at Sacramento and *Salinas City, 26° at Red Bluff, 27° at Visalia and *Princeton, 30° at Los Angeles and 37° at San Francisco. *Oregon*: 18° at Umatilla, 25° at Roseburg and 26° at Portland.

Those marked with a star (*) are reported by Voluntary Observers or U. S. Army Post Surgeons.

Ranges of Temperature at Signal Service Stations.—The monthly ranges will appear from an examination of the maxima and minima just given. The greatest daily ranges vary in New England from 25° at Wood's Holl to 36° at Eastport and 40° at New London and Boston; Middle Atlantic States, 20° at Barnegat to 27° at Washington, Baltimore and Sandy Hook, and 36° at Albany; South Atlantic States, 22° at Savannah to 26° at Jacksonville, and 31° at Wilmington and Augusta; Eastern Gulf States, 13° at Key West and 18° at New Orleans and Cedar Keys to 31° at Montgomery; Western Gulf States, 16° at Galveston to 31° at Vicksburg and 32° at Corsicana; Ohio valley and Tennessee, 22° at Columbus to 25° at Memphis, 30° at Knoxville, 33° at Pittsburg and 36° at Morgantown; Lower Lake region, 23° at Detroit to 31° at Oswego and 34° at Rochester; Upper Lake region, 24° at Grand Haven to 29° at Madison, 33° at Alpena, 38° at Marquette and 48° at Duluth; Upper Mississippi valley, 28° at Dubuque to 31° at St. Louis, 37° at St. Paul and 40° at LaCrosse; Missouri valley, 35° at Leavenworth to 39° at Yankton, 52° at Bismarck and 62° at Pembina; Texas, 31° at San Antonio and Denison to 40° at Rio Grande, 50° at Uvalde, 51° at Fort Elliott and 55° at Decatur; Eastern Rocky Mountain slope, 32° at Fort Gibson and Fort Sill to 36° at Deadwood and 44° at Dodge City and North Platte; Rocky Mountains, 25° on Pike's Peak to 32° at Virginia City, 34° at Cheyenne and 42° at Denver; Northern and Middle Plateau districts, 23° at Boise City to 25° at Salt Lake City and 33° at Winnemucca; California, 15° at San Francisco to 22° at Sacramento, 31° at Los Angeles, 33° at Red Bluff and 36° at Visalia.

Frost was reported very generally from all States and Territories north of the 35th parallel. In Florida, on the 19th, but causing no injury to vegetation; Gulf States, 14th, 19th, 21st to 27th; interior of Texas, 13th, 14th, 22nd, 23rd, 24th, 25th, 26th, 31st; New Mexico, 1st, 5th, 11th, 12th, 13th, 20th, 22nd, 23rd, 26th, 27th, 30th, 31st; Arizona, 2nd, 3rd, 4th, 5th, 6th, 9th, 12th, 13th to 20th, 22nd to 31st; California, 1st, 2nd, 7th, 9th, 11th, 12th, 13th, 14th, 15th, 16th, 19th, 20th, 21st, 26th to 31st; at Salinas, Cal., frost was reported as frequent and severe; at Los Angeles, on the 31st, it injured tender vegetation, but fruit trees not seriously.

Ice formed generally throughout the northern sections of the country as will be seen by reference to the chapter on navigation. In the South Atlantic States on the 13th, 14th, 25th, 26th; Mississippi, 14th, 23rd, 24th, 25th, 26th, 27th; California, 10th, 11th, 12th, 13th, 28th, 29th, 30th, 31st.

Ground Frozen.—Litchfield, Pa., 30th, ground frozen to a depth of 4 inches; Bloomfield, Wis., ground frozen only at intervals throughout the month; Fall River, Mass., frost in ground during first half of month.

PRECIPITATION.

The general distribution of the rain-fall, including melted snow, is illustrated upon chart No. III, as accurately as possible from about 500 reports. In the left-hand corner is a table of average rain-falls, by districts. This table shows the rain-fall for the present January to have been below the average in the Atlantic and Gulf States, Tennessee, (eastern part,) Lower Lake region, Upper Missouri valley and California; the largest deficiencies occurring in the East Gulf States and California. In the other districts, namely, the Upper Lake region, the Ohio, Upper Mississippi and Lower Missouri valleys, and on the coast of Oregon there is an excess, which is most marked in the last named section.

Special Heavy Rains.—1st and 2nd, Eugene City, Or., 4.20 inches. 1st to 3rd, Brackettsville, Tex., 5.00 in. 2nd, Louisville, Ill., 2.00 in. in five hours; Concho, Tex., 3.60 in. 2nd and 3rd, Lyndon, Ill., 2.62 in. 3rd, Riley, Ill., 2.97 in.; Austin, Tex., 2.00 in.; Castroville, Tex., 2.08 in.; San Antonio, Tex., 2.20 in.; Berne, Tex., 2.53 in. 3rd and 4th, Marengo, Ill., 3.02 in.; New Ulm, Tex., 4.75 in.; Indianola, 4.08 in. 4th, Fort Wayne, Ind., 3.00 in. 5th, Memphis, 2.92 in. 5th and 6th, New Corydon, Ind., 2.49 in.; St. Meinrad, Ind., 3.35 in.; Portland, Or., 3.34 in. 5th to 7th, Eugene City, Or., 4.55 in. 8th and 9th, Princeton, Cal., 2.80 in. 20th to 22nd, Wellsboro', Pa., 4.50 in.; White Plains, N. Y., 3.10 in. 22nd, Auburn, N. H., 3.04 in. 25th and 26th, Quitman, Ga., 3.90 in.; Thomasville, Ga., 3.67 in. 26th, Wilmington, N. C., 2.55 in. 26th and 27th, Smithville, N. C., 3.63 in. 27th, Wellsboro', Pa., 2.40 in. 27th and 28th, Auburn, N. H., 6.00 in. White Plains, N. Y., 2.70. 29th, Pike's Peak, 27th to 29th, 3.64 in.

Largest Monthly Rain-falls including melted snow.—Olympia, Wash. Ty., 19.69 inches; Auburn, N. H., 14.16; Portland, Or., 12.27; Roseburg, Or., 9.37; Wellsboro, Pa., 8.71; College Hill, Ohio, 8.28; New

Corydon, Ind., 7.84; Memphis, 6.87; Summit, Cal., 6.60; New Ulm, Tex., 6.44; St. Meinrad, Ind., 6.40; Brackettsville, Tex., 6.39; Spiceland, Ind., 6.00; Morgantown, 5.77; Jacksonburg, Ohio, 5.75; Princeton, Cal., Vevay and Fort Wayne, Ind., and North Lewisburg, Ohio, 5.50; Quitman, Ga., 5.40; Portland, Me., 5.36; Urbana, Ohio, 5.35; Bellefontaine, Ohio, 5.33; Weir's Bridge, N. H., 5.23; Smithville, N. C., 5.05; Cape Lookout, N. C., 5.01.

Smallest Monthly Rain-falls including melted snow.—Fort Halleck, Nev., none; Fort Elliott, Tex., Fort Lyon, Col., Yuma, Ariz., Fort McDermit, Nev., Fort Abraham Lincoln, Dak., and Dodge City, Kan., trace; Fort Wallace, Kan., 0.01 in.; North Platte, 0.03; Fort McPherson, Neb., and Fort Buford, Dak., 0.10; Fort Fetterman, Wy. Ter., and Corning, Mo., 0.13; Stockton and Pilot Point, Tex., and La Mesilla, N. M., 0.14; Socorro, N. M., 0.15; Cheyenne, 0.20; Camp Sheridan, Neb., and Fort Hale, Dak., 0.22; Sidney, Neb., 0.24; Morrilton, Dak., 0.25; Pembina, Dak., and Winnemucca, Nev., 0.26; Fort Stevenson, Dak., 0.27; Santa Fe, 0.28; Burkes, Ariz. and Salt Lake City, 0.29; Bismarck and Fort Gibson, 0.30; Prescott, Ariz., 0.35; Denver, 0.38; Olivet, Dak., 0.39; Fort Garland, Col., and Wellington, Kan., 0.46; Silver City, N. M., 0.47; Fort Douglass, Utah, 0.52; Holton, Kan., 0.53; Manhattan, Kan. and Umatilla, Or., 0.56; Fort Sill, Ind. Ter., and Creswell, Kan., 0.58; Deadwood, 0.59; Genoa, Neb., 0.60.

Rainy Days.—The number of days on which rain or snow has fallen, varies as follows: New England, 9 to 21; Middle Atlantic States, 11 to 20; South Atlantic States, 6 to 19; Eastern Gulf States, 5 to 12; Western Gulf States, 7 to 12; Lower Lake region, 13 to 20; Upper Lake region, 12 to 21; Ohio valley and Tennessee, 11 to 17; Upper Mississippi valley, 10 to 15; Missouri valley, 1 to 9; Red River of the North valley, 5 to 7; Eastern Rocky Mountain Slope, 2 to 13; Texas, 2 to 11; Rocky Mountains, 1 to 8; Middle Plateau, 6 to 10; California, 5 to 9; Oregon, 12 to 23.

Cloudy Days.—The number varies in New England from 9 to 16; Middle Atlantic States, 5 to 14; South Atlantic States, 8 to 17; Eastern Gulf States, 3 to 20; Western Gulf States, 5 to 14; Lower Lake region, 8 to 17; Upper Lake region, 8 to 17; Ohio valley and Tennessee, 8 to 15; Upper Mississippi valley, 9 to 14; Missouri valley, 7 to 12; Red River of the North valley, 6 to 9; Eastern Rocky Mountain Slope, 4 to 10; Texas, 0 to 16; Rocky Mountains, 0 to 6; Middle Plateau, 6 to 19; California, 1 to 10.

Hail was reported in the various states on the following days: New Hampshire, 3rd, 6th; Massachusetts, 12th; Connecticut, 25th; New Jersey, 13th, 31st; Pennsylvania, 6th, 12th, 20th; Maryland, 20th; Ohio, 23rd; Indiana, 11th, 24th; Illinois, 29th; Tennessee, 21st, 22nd; Mississippi, 22nd; Louisiana, 22nd; Texas, 31st; Missouri, 29th; Kansas and Nebraska, 29th; Iowa, 9th, 19th, 24th, 29th.

Snow fell on the following dates in the various districts: New England, 1st, 3rd, 4th, 6th, 7th, 8th, 9th, 11th, 12th, 13th, 15th to 31st; Middle Atlantic States, 3rd, 6th, 10th, 11th, 12th, 13th, 14th, 15th, 20th, 22nd, 23rd, 27th, 30th, 31st; North Carolina, 13th; Tennessee, 12th; Lower Lake region, 1st, 11th, 12th, 13th, 15th, 20th, 21st, 22nd, 23rd, 24th, 29th, 31st; Ohio valley, 5th, 12th, 13th, 15th, 20th, 22nd, 23rd, 25th; Upper Lake region, 8th, 9th, 10th, 11th, 13th, 14th, 15th, 17th, 19th, 20th, 21st, 22nd, 23rd, 26th to 31st; Upper Mississippi valley, 9th, 10th, 11th, 13th, 19th to 31st; Missouri valley, 6th, 8th, 10th, 11th, 19th to 23rd, 24th to 31st; Rocky Mountains, 8th, 9th, 10th, 12th, 13th, 14th, 15th, 19th, 21st, 22nd, 23rd, 25th, 26th, 27th, 28th, 29th; Middle Plateau District, 8th, 9th, 10th, 14th, 15th, 19th, 22nd, 23rd, 25th, 27th, 28th, 29th. In Arizona on the 28th a very heavy snow-storm, accompanied with high winds. California, 9th, 25th, 26th, 27th, 28th; on the 26th snow fell to the depth of 2 inches at several places, and in relation to which the following notes are of interest: Shasta, snowing all day, very cold; Watsonville, rain and snow in morning, more snow fell than at any time for last 15 years; Calistoga, snow 1 inch deep in morning, heaviest fall for past 6 years; Davisville, began snowing at daylight, $\frac{1}{2}$ inch fell in 3 hours; Santa Rosa, began snowing at midnight, first time snow has remained on ground for past 6 years; Napa, 7 a. m., temperature 34°, 2 inches of snow in valley and on surrounding hills, much heavier on mountains at head of valley, heaviest snow for past 6 years; Ukiah, 4 a. m. to noon, severe storm, 2 inches of snow here, at Low Gap 5 inches, and at Little Lake, 4 inches; Salinas, 7 a. m., rain turned to heavy snow, which fell for 2 hours, first snow on record in Salinas valley; Gonzales, 7. 0 a. m., light snow, the last snow occurred about 10 years ago; Santa Paula, snow lower on mountains than for past 9 years; On the 27th at Los Angeles the snow-fall was the heaviest ever known in that section; first snow for past 14 years. At Grass Valley, 8 p. m., the snow was 6 in. deep and falling fast; at Georgetown, 8 p. m., 12 in. deep; at Rio Vista, 1 inch and at Dixon, at 6 p. m., it was snowing hard. On the 28th, at Visalia, first snow for the past 11 years; at Banta, San Joaquin county, 28th, snow covered the hills and valleys. Campo, 28th, clear sky again after the most severe snow-storm for many years, snow 3 feet all over the high mountains. Washington Ty., 2nd, 3rd, 5th, 8th, 9th, 10th, 11th, 12th, 25th.

Largest Monthly Snow-falls.—Summit, Cal., 66.00 inches; Pikes Peak, 42.60 in.; Truckee, Cal., 29.50 in.; Mt. Washington, 25.60 in.; Grafton, N. H., 22.75 in.; Hermosa, Col., 22.00 in.; Escanaba, 20.60 in.; Cornish, Me., and Strafford, Vt., 19.00 in.; Woodstock, Vt., Neillesville, Wis., and Tehachapi, Cal., 18.50 in.; Dunbarton and Autrim, N. H., 17.00 in.; Embarrass, Wis., 16.50 in.; Northport, Mich., 16.10 in.; Auburn, N. H., 14.50 in.; Gardner, Me., 14.00 in.; Orono, Me., Contoocookville, N. H., Lunenburg, Vt., and Keene, Cal., 13.00 in.; Newport, Vt., 12.50 in.; Duluth, 9.00 in.; Catawissa, Pa., 8.10 in.

Snow from a Cloudless Sky.—Bismarck, Dak., 29th.

The *depth of snow on ground at end of month* was reported as follows:—In Maine, from 3 to 10 in.; New Hampshire, 2 to 10 in. on the low-lands and 12 to 36 in. on the summit of Mt. Washington; Vermont, 1 to 12 in.; New York, trace to $\frac{1}{2}$ in. in the interior; Lower Lake region, trace to $\frac{1}{2}$ in.; West Virginia, trace; Michigan, $\frac{1}{2}$ to $\frac{1}{2}$ in. in the interior; Upper Lake region, $\frac{1}{2}$ in. at Alpena to 20 in. at Duluth; Wisconsin, trace to $\frac{1}{2}$ in.; Minnesota, $1\frac{1}{2}$ to 6 in.; Iowa, $\frac{1}{2}$ to $2\frac{1}{2}$ in.; Nebraska, trace to $1\frac{1}{2}$ in.; Dakota, $\frac{1}{2}$ to $2\frac{1}{2}$ in.; Wyoming Territory, 2 in.; Colorado, 3 to 24 in. on the low-lands and 6 to 45 in. on the summit of Pike's Peak; New Mexico, 1 in.; Nevada, trace to 3 in.

Floods.—New Orleans, La., 30th, high water damaged the levee both above and below the city.

RELATIVE HUMIDITY.

The percentages of mean relative humidity for the month range as follows: New England, 70 to 84; Middle Atlantic States, 72 to 85; South Atlantic States, 71 to 88; Eastern Gulf States, 72 to 81; Western Gulf States, 67 to 81; Lower Lake region, 70 to 80; Upper Lake region, 66 to 80; Ohio valley and Tennessee, 60 to 74; Upper Mississippi valley, 66 to 74; Missouri valley, 62 to 83; Red River of the North valley, 92 to 95; Eastern Rocky Mountain Slope, 49 to 63; Texas, 22 at Stockton to 75 at Brackettsville and Laredo; Western Plateau, 40 at Yuma to 65 at Boise City; California, 65 to 80; Oregon, 69 to 82. *High stations* report the following averages not corrected for altitude: Mt. Washington, 86.5 per cent. Pike's Peak, 52.4; Denver, 39.8; Cheyenne, 38.7; Virginia City, 53.3; Santa Fe, 44.6.

WINDS.

The *prevailing direction of the winds* for the month is shown by arrows flying with the wind, on chart No. II. In general they agree with what might be expected from the distribution of pressure, being *north-erly* along the Atlantic coast and in the extreme Northwest; *southerly* from the Gulf coast to the Lakes, over the Plateau districts, in the Sacramento valley, Oregon and Washington Territory; at San Diego and San Francisco the prevailing wind was northerly. The *maximum velocities*, as recorded by self-registers, have been noted in the description of high and low areas. The *maximum* on the summit of Pike's Peak SW. 95 miles occurred on the 8th, and on the summit of Mt. Washington, NW. 138 miles on the 10th, both of them during the passage of low area No. V.

Total Movements of the Air.—The following are the *largest* total movements recorded in miles at the Signal Service stations during the month: On the summit of Pike's Peak, 21,238 miles; Cheyenne, 11,789; Cape Lookout, N. C., 11,181; Thatcher's Island, Mass., 11,081; Portsmouth, N. C., 10,734; Kittyhawk, N. C., 10,574; Milwaukee, 10,330; Sandusky, 10,142; Sandy Hook, 9,911; Cape Hatteras, 9,587; Cape May, 9,425; Key West, 9,110; Barnegat, N. J., 8,987; Burlington, Vt., 8,867; Eastport, 8,798; Cape Henry, 8,788; North Platte, 8,769. The *smallest* are La Mesilla, N. M., 1,541 miles; Nashville, Tenn., 1,692; Visalia, Cal., 1,871; Lynchburg, Va., 1,958; Uvalde, Tex., 2,263; Augusta, Ga., 2,380; Socorro, N. M., 3,031; El Paso, Tex., 3,119; Davis, 3,137; Los Angeles, Cal., 3,214; Silver City, N. M., 3,231; Montgomery, 3,254; San Antonio, 3,274; Salt Lake City, 3,516; La Crosse, 3,520.

Sand Storms.—Burkes, Ariz., 26th, 27th.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for January, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 84.4 per cent. The percentages for the four elements are: Weather, 86.9; Direction of the Wind, 83.2; Temperature, 84.5; Barometer, 82.7 per cent. By geographical districts they are: for New England, 85.8; Middle States, 85.8; South Atlantic States, 84.4; Eastern Gulf States, 80.7; Western Gulf States, 80.7; Lower Lake region, 84.3; Upper Lake region, 87.8; Tennessee and the Ohio valley, 84.9; Upper Mississippi valley, 84.9; Lower Missouri valley, 82.7; Northern Pacific region, 84.7; Central Pacific coast region, 90.3; Southern Pacific coast region, 96.0. There were 10 omissions to predict out of 3,813, or 0.26 per cent. Of the 3,803 predictions that have been made, 156, or 4.10 per cent, are considered to have entirely failed; 129, or 3.39 per cent, were one-fourth verified; 471, or 12.39 per cent, were one-half verified; 421, or 11.07 per cent, were three-fourths verified; 2,626, or 69.05 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

Cautionary Signals.—160 Cautionary Signals were displayed during the month, of which 119, or 74.4 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 46 Off-shore Signals were displayed, of which 40, or 87.0 per cent, were fully justified; 42, or 91.3 per cent, were justified as to direction; 41, or 89.1 per cent, were justified as to velocity; and 3, or 6.4 per cent, were not justified either as to direction or velocity. 29 of the Off-shore were changed from Cautionary. 206 Signals of both kinds were displayed, of which 159, or 77.0 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 48 cases of winds of 25 miles and over per hour, from scattering stations, were reported, and for which signals had not been ordered. Eight signals were reported late.

NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river-gauges for the month, with the dates of the same. The *Missouri* remained frozen over at and above Omaha, throughout the entire month. At Omaha, on the 21st, the ice melted in the immediate vicinity of the gauge and observations on height of river were resumed; the water slowly fell from the above date to the end of the month; at Leavenworth the observations were resumed on the 7th, and the river remained low throughout the month. The *Mississippi* remained closed at and above Le Claire; observations were resumed at Dubuque on the 18th, at Davenport on the 7th, and at Keokuk on the 3rd; at Dubuque and Davenport the river continued to fall to end of month; at Keokuk it rose to 10 feet on the 4th, fell to 6 feet on the 8th, rose to 8 feet on the 10th, after which it fell to end of month; at St. Louis it rose from 1st to 10th, and then fell to end; at Cairo it fell from 37 feet 4 inches (within 3 feet of danger line) on the 2nd to 33 feet 7 in. on the 8th, rose to 42 feet 11 in. (3 feet above danger line) on the 16th, and then fell to 24 ft. 7 in. by end; at Memphis rose from 27 ft. 7 in. on 1st to 32 ft. 5 in. (within 19 in. of danger line) on the 19th, then fell to end; at Vicksburg it rose from 30 ft. 11 in. on the 1st to 40 ft. 11 in. (danger line 41 ft.) at end of month; at New Orleans it rose from the 1st to the end of month, when it was within 9 in. of the danger line. The *Tennessee*, at Chattanooga, fell from the 1st to 6th, rose to 11th and fell to end of month. The *Cumberland*, at Nashville, fell from 1st to 6th, rose to 9th to 16 ft. 6 in., it then remained almost stationary to the 15th, after which a general fall set in which continued to end. The *Ohio*, at Pittsburg, fell from 15 ft. on the 18th to 11 ft. 7 in. on the 5th, rose to 17 ft. 3 in. on 7th, fell to 6 ft. 2 in. on the 16th, rose to 9 ft. 3 in. on 22nd, and fell to end of month; at Cincinnati it arose from 24 ft. on 2nd to 42 ft. 2 in. (8 ft. below danger line) on 9th, and fell to 19 ft. 3 in. at end; at Louisville it fell from 14 ft. 6 in. on 1st to 9 ft. 6 in. on 4th, rose to 19 ft. 6 in. (5 ft. from danger line) on the 8th, and fell to end of month. The *Savannah* oscillated between 6 and 7 ft. from 1st to 8th, rose to 13 ft. 6 in. on the 10th, fell to 6 ft. 8 in. on 21st, rose to 12 ft. on 28th and fell to end.

Ice in Rivers and Harbors.—The following notes on the formation of ice are of interest: *Columbia River.*—Portland, Or., 3rd, navigation between this city and the cascades reopened; river nearly clear of ice. *Fraser.*—New Westminster, river open on the 16th. *Missouri.*—Yankton, Dak., and Omaha, Neb., river frozen over throughout the month. *Plattsmouth, Neb.*, 8th, ice in river very rotten but held in place by the pile bridge and lack of a rise; 19th, ice breaking up and moving slowly; 20th to 28th, small ice gorges forming at several places, but finally freezing over the second time on the 29th. *St. Joseph, Mo.*, 8th, ice breaking up; 10th, river clear of ice. *Leavenworth, Kan.*, 5th, ice melting rapidly; 6th, breaking up; 7th, ice gorged, carrying away river gauge and causing other damage; 8th, 9th, river full of floating ice; 10th, river clear; 29th, 30th, 31st, floating ice in river. *Kansas City, Mo.*, 5th, ice breaking up; 6th, 7th, 8th, ice running out of river; 9th, river clear of ice; 11th, floating ice. *Brunswick, Mo.*, 5th, drift wood in river, destroying river gauge. *Boonville, Mo.*, 4th, ice breaking up, gorges forming. *Platte River.*—Clear Creek, Neb., 1st, 8th, 19th, floating ice in river; 28th, river frozen over hard. *Plattsmouth, Neb.*, 12th, ice melting rapidly, dangerous for travel. *Mississippi.*—La Crosse, 18th, ice on river becoming soft and unsafe for travel, but throughout the month the river remained closed. *Dubuque, Ia.*, 12th ice breaking up; 15th, frozen over; people crossing on the ice; 16th, open in several places; 18th, all travel across river ceased; 19th, ice breaking up; 21st, floating ice; 26th, river nearly clear of ice; 27th, ferry-boats making trips; 31st, river full of floating ice. *Le Claire, Ia.*, 31st, river entirely frozen over. *Davenport, Ia.*, 4th, ice breaking up; 5th, 6th, 7th, 8th, gorged, causing considerable damage to wharves; 9th, floating ice; steamer arrived from Le Claire; floating ice also on the 12th, 13th, 14th, 15th, 23rd, 24th, 28th to 31st. *Muscataine, Ia.*, 9th, ice breaking up; 18th, river clear. *Burlington, Ia.*, 6th, ice breaking up; all travel across the river ceased; large ice floes floating down the river; 8th, river clear; 10th to 16th, floating ice; 18th, river clear; 31st, large quantities of floating ice. *Fort Madison, Ia.*, 30th, first boat passed down the river; river clear of ice. *Keokuk, Ia.*, 2nd, ice breaking up; 3rd, moving out slowly; 4th, ice gorged in places, river rising rapidly; 5th, heavy floating ice, gorged in places; river clear along the Illinois side, but closed on the Iowa side; considerable damage done to bridge piers; 6th, Iowa side and main channel clear; navigation opened; river falling rapidly; 8th, steamer arrived from Montrose; 9th and 10th, heavy floating ice; 11th to 13th, small quantities of floating ice; 14th, heavy floating ice; 15th, heavy floating ice; steamer Arkansas left for St. Louis; 16th, first boat arrived from St. Louis; small quantities of floating ice; 17th to 24th and 29th, floating ice; 31st, heavy floating ice. *St. Louis*, 1st, 2nd, 3rd, 4th, small quantities of floating ice in river; navigation resumed; 5th, river clear of ice; 8th, drift-wood in river. *Cairo, Ill.*, 1st to 3rd, floating ice in river. *Iowa.*—Des Moines, Ia., 9th, ice breaking up and floating out rapidly. *Rock river.*—Rockford Ill., 6th, floating ice in river; 7th, river clear of ice; 29th, floating ice. *Lyndon, Ill.*, 5th, ice passed out of river, causing serious inundations wherever gorges were formed. *Kishwaukee.*—Belvidere, Ill., 4th, river rising rapidly, mill-dam destroyed by floating ice. *Ohio river.*—Wellsburg, W. Va., no ice in the river, at this point, this winter. *Lake Superior.*—Duluth, 14th, ice in harbor breaking up and drifting away; 21st, large quantities of floating ice in bay; 22nd, ice forming in lake rapidly. *Lake Michigan.*—Chicago, 3rd, ice breaking up in river and along lake front. *Grand Traverse Bay.* Northport, Mich., bay free of ice throughout the month. *Detroit river.*—Detroit, 1st to 3rd, ice forming along shore; 9th to 14th, floating ice; 15th, clear of ice. *Lake Erie.*—Toledo, 4th and 5th, ice breaking up and running out; 7th, free of ice; 10th, navigation opened between this port and Detroit;

15th, tug Carrington left for Port Sarnia. Cleveland, 21st, scow arrived loaded with stone, first boat since close of navigation. Sandusky, 3rd, ice breaking up; 5th, large masses moving out; 9th, first steamer arrived. Buffalo, 1st, creek and harbor free of ice. *Hudson River*.—Albany, 28th, river entirely free of ice, rose 11 feet in past 36 hours, causing considerable damage to property. *Watuppa Lake*.—Fall River, Mass, lake clear of ice throughout the month. *Lake Champlain*.—Burlington, Vt., 1st, 22nd to 25th, 28th, 31st, floating ice in lake. *Merrimac River*.—Newburyport, Mass, river and harbor free of ice throughout the month, except on the 1st, 14th, 27th, 28th, 30th, when small quantities of floating ice appeared.

High Tides.—Cape Lookout, N. C., 14th, 15th, 26th, Fort Macon, N. C., 11th, 12th, 13th to 16th; Portsmouth, N. C., 14th,

Low Tides.—Indianola, Tex., 1st, 2nd, 10th, 11th and 12th.

TEMPERATURE OF WATER.

The temperatures of water, as observed in rivers and harbors, with average depth at which observations were taken, are given in the table on left side of chart No. II. At the following stations observations were not made on the dates indicated, on account of ice, at Alpena and Escanaba during entire month; Chicago, 1st, 2nd and 3rd; Detroit, 1st, 2nd, 3rd, 10th, 11th, 12th; Duluth, 1st to 13th inclusive, 22nd to end of month; Grand Haven, 1st, 2nd and 3rd; Marquette, 28th to 31st; Sandusky and Toledo 1st to 6th.

ATMOSPHERIC ELECTRICITY.

Thunder-storms were reported in the various states and territories on the following dates: Pennsylvania, 20th, 21st; New Jersey, Maryland, Virginia and West Virginia, 20th; North Carolina, 9th, 22nd; Georgia, 8th, 21st, 26th, 27th; Florida, 25th; Alabama, 17th, 21st; Mississippi, 21st, 22nd; Louisiana, 5th, 21st; Texas, 1st, 2nd, 3rd, 4th, 24th, 29th, 30th, 31st; Arkansas, 7th; Indian Territory, 29th; Tennessee, 6th, 21st, 22nd at Nashville the thunder-storm of the 21st was very severe, the heavy peals of thunder and vivid flashes of lightning, 10:10 p. m. being a marked feature of the storm; Kentucky, 7th, 8th, 21st; Ohio, 8th, 21st, 22nd; Illinois, 7th, 8th, 21st; Indiana, 7th, 8th, 12th, 17th, 21st; Missouri, 19th, 21st, 29th; Iowa and Nebraska, 29th; Kansas, 22nd, 29th.

Auroras.—Harvard College Observatory, Cambridge, Mass., looked for every clear evening, but none seen. Guttentburg, Ia., 28th, 9 p. m., diffuse light, no streamers; Independence, Ia., 16th; Gardiner, Me., 28th; Austin, Nebr., 4th; Starkey, N. Y., 11th, 20th, 24th; Milton, Pa., 11th, 7 p. m., arch extended from northeast to southwest, disappeared at 8:40 p. m.; Coalville, Utah, 30th; Tucson, Ariz., 8th; Eastport, 7th, 11:40 p. m., 8th, 3 a. m.; Newport, R. I., 4th, 11:30 p. m.; Burlington, Vt., 7th.

Telegraphic Communication interfered with by Atmospheric Electricity.—Mason, Tex., 2nd, 3rd; Davis, Tex., 1st, 2nd; Cape Hatteras, N. C., 22nd.

OPTICAL PHENOMENA.

Solar Halos were observed in the various districts on the following dates: New England, 16th, 17th, 18th, 22nd, 24th, 25th, 26th, 28th, 29th; Middle Atlantic States, 2nd, 3rd, 5th, 16th, 17th, 18th, 19th to 30th; South Atlantic States, 1st, 3rd, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 22nd, 23rd, 24th, 25th, 27th, 28th; Eastern Gulf States, 19th, 20th, 21st, 22nd, 23rd, 24th, 25th, 28th; Western Gulf States, 15th, 16th, 17th, 18th, 19th, 21st, 22nd, 23rd, 24th, 26th, 28th, 29th; Lower Lake region, 17th, 19th, 21st, 24th, 25th, 27th, 28th, 29th, 31st; Upper Lake region, 5th, 16th, 17th, 24th, 25th, 26th, 27th, 28th, 29th; Ohio valley and Tennessee, 1st, 2nd, 14th, 15th, 16th, 19th, 20th, 21st, 23rd to 29th; Upper Mississippi valley, 1st, 15th to 29th; Missouri valley, 2nd, 4th, 14th to 20th, 24th to 31st; Eastern Rocky Mountain slope, 1st, 2nd, 14th, 17th, 18th, 23rd, 25th, 27th, 28th; Rocky Mountains, 15th, 20th, 21st, 23rd, 24th, 29th; Western Plateau, 17th, 18th, 21st, 23rd, 24th, 26th, 27th; California, 2nd, 4th, 19th, 22nd, 24th, 25th, 26th.

Lunar Halos were observed in the various districts on the following dates: New England, 5th, 13th, 15th, 17th, 25th, 26th, 27th, 30th; Middle Atlantic States, 5th, 15th, 16th, 17th, 21st, 23rd, 25th, 26th, 30th; South Atlantic States, 20th, 21st, 23rd; Eastern Gulf States, 5th, 16th, 19th, 20th, 22nd, 23rd; Western Gulf States, 9th, 19th, 29th; Lower Lake region, 6th, 8th, 9th, 10th, 11th, 19th, 20th, 25th; Upper Lake region, 13th, 16th, 18th, 24th, 26th, 28th; Ohio valley, 1st, 14th, 24th, 25th, 26th, 28th, 29th; Upper Mississippi valley, 10th, 11th, 14th, 15th, 17th, 19th, 23rd, 24th, 25th, 26th, 28th, 30th, 31st; Missouri valley, 5th, 11th, 16th, 19th, 20th, 23rd, 24th, 25th, 26th, 27th, 28th; Rocky Mountains, 7th, 15th, 18th, 27th, 28th, 29th; California, 9th, 11th, 24th, 29th.

Mirage.—Olivet, Dak., 30th; Genoa, Neb., 17th, 18th, 22nd, 23rd, 24th, 30th, 31st; Pembina, Dak., 20th, 23rd, 24th.

MISCELLANEOUS PHENOMENA.

Sunsets.—The characteristics of the sky at sunset, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service Stations. Reports from 137 stations show 4,183 observations to have been made, of which 35 were reported doubtful; of the remainder, 3,486, or 84.0 per cent., were followed by the expected weather.

Meteors.—Wabash, Ind., 19th, between 5 and 6 a. m., "a large meteor passed over the city making the

whole heavens a brilliant glow of light. It was apparently some three feet in diameter and left behind it a long fiery train of different colored sparks." Southington, Conn., 2nd; Lyndon, Ill., 12th, 15th; New Corydon, Ind., 10th, 12th, 13th, 15th, 19th, 24th; Monticello, Ia., 6th; Yates Center, Kan., 5th, 7th; Woodstock, Md., 3rd, 10th, 16th, 24th, 29th, 31st; Rowe, Mass., 1st, 2nd, 15th; Fall River, Mass., 31st; Fayette, Miss., 3rd, 10th; Ashley, Miss., 17th; Clear Creek, Neb., 3rd, 31st; Genoa, Neb., 7th; Grafton, N. H., 21st; Freehold, N. J., 17th, 31st; Waterburg, N. Y., 2nd, 10th, 13th; Starkey, N. Y., 16th; Jacksonburg, Ohio, 18th; Los Angeles, Cal., 8th; Dodge City, 9th; Davis, Tex., 8th; Mobile, Ala., 30th; Pensacola, Fla., 10th; Milwaukee, Wis., 6th.

Earthquakes.—Key West, 22nd, 11:10 p. m., "severe shock passed over the island, lasting one minute; a rocking motion, from southwest to northeast, was felt by many persons in the upper stories of buildings along a path not more than 100 yards wide; vessels in the harbor did not feel the shock, and no noise accompanied it." Havana, Cuba, 22nd, 11:04 p. m., "light shock of ten seconds duration, three oscillations from southeast to northeast; 23rd, 3:45 p. m., another light shock of less duration; 26th, at about 5 a. m., still another shock was experienced by many persons; in the western portion of the island shocks have been generally felt for several days, accompanied with continued subterranean thunder or roaring; the boroughs of San Cristobal and Candelaria are in ruins, and several persons killed, wounded and contused; on the night of the 29th, four light shocks were felt at San Cristobal. On the Isle of Pines, 22nd, shock at 11 p. m.; 23rd, at 4 a. m. and 9 p. m.; 26th, at 4:30 p. m. and 1 p. m." San Salvador, C. A., 22nd, "violent shocks were felt in the interior; much damage is reported from Libertas; the earth at this place seemed literally to be dancing; persons were thrown to the ground and many buildings suffered; the lake of Ilopango was in motion like a boiling cauldron, emitting dense sulphurous vapors; industries of all kinds suspended." In California on the 9th "at Hollister, San Benito county, about 6 a. m., heaviest earthquake shock ever felt here; vibrations from NE. to SW. continued over twenty seconds; Gonzales, Monterey county, 5:45 a. m., quite a perceptible shock felt; Santa Cruz, Santa Cruz county, 5:45 a. m., shock from N to S., lasting from fifteen to twenty seconds." Yokohama, Japan, December 3rd, 1879, 7:09 a. m., severe shock; duration, 20 seconds; at 9:45 a. m., light shock; 7th, 5:10 a. m., light shock; 11 a. m., light shock.

Polar Bands.—New Corydon, Ind., 1st, 13th, 15th, 17th, 24th, 26th, 27th, 31st; Guttenburg, Iowa, 28th; Glenwood, Iowa, 4th, 11th, 19th; Yate's Center, Kan., 11th; Gardiner, Me., 15th, 28th; Thornville, Mich., 4th, 24th; Clear Creek, Neb., 4th, 5th, 8th, 10th, 11th, 14th, 15th, 16th, 18th, 19th, 20th, 23rd, 25th; Auburn, N. H., 15th, 26th; Vineland, N. J., 21st, 26th; Wytheville, Va., 24th, 25th, 26th, 28th; Toledo, 24th; Barnegat, N. J., 28th; Atlantic City, N. J., 28th.

Prairie and Forest Fires.—Morrison, Dak., 18th; Ft. Dodge, Kan., 13th to 19th; Glenwood, Ia., 16th; Creswell, Kan., 5th, 8th, 9th, 11th, 14th, 15th, 18th to 22nd, 25th, 27th, 28th, 30th; Independence, Kan., 9th, to 29th; Wellington, Kan., 23rd; Lake Charles, La., 24th; North Platte, 10th; Deadwood, Dak., 8th; Ft. Gibson, Ind. Ty., 9th, 11th, 12th, 14th, 16th; Henrietta, Tex., 11th, 16th, 17th.

Sun Spots.—The following record of observations made by Mr. D. P. Todd, Assistant, N. A. O., has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

| DATE— Jan., 1880. | No. of new— | | Disappeared by solar rotation. | | Reappeared by solar rotation. | | Total number visible. | | REMARKS. |
|----------------------|-------------|--------|-----------------------------------|--------|----------------------------------|--------|--------------------------|-------|--|
| | Groups | Spots. | Groups | Spots. | Groups | Spots. | Groups | Spots | |
| 1st, 12 m. | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | { Spots small. |
| 1st, 3 p. m. | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | |
| 4th, 1 p. m. | 3 | 22 | 0 | 0 | 3 | 22 | 4 | 24 | { Faculae; many of the spots small. The new spots probably reappeared by solar rotation. |
| 8th, 2 p. m. | 0 | 0 | 2 | 8 | 0 | 0 | 2 | 16 | |
| 10th, 8 a. m. | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 24 | { A few of the spots very large. |
| 10th, 3 p. m. | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 26* | |
| 13th, 9 a. m. | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 26* | { Faculae. |
| 14th, 9 a. m. | 1 | 4 | 0 | 0 | 0 | 0 | 4 | 30* | |
| 14th, 4 p. m. | 0 | 0 | 1 | 4 | 0 | 0 | 3 | 26* | { Faculae. |
| 15th, 3 p. m. | 1 | 4 | 1 | 10 | 1 | 4 | 3 | 30* | |
| 18th, 10 a. m. | 0 | 0 | 1 | 10 | 0 | 0 | 2 | 10 | { Faculae. |
| 18th, 4 p. m. | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 | |
| 19th, 9 a. m. | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 7 | { Faculae. |
| 21st, 9 a. m. | 0 | 0 | 1 | 5 | 0 | 0 | 1 | 2 | |
| 23th, 9 a. m. | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | { Faculae. |
| 24th, 2 p. m. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 26th, 5 p. m. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | { Several groups of faculae. |
| 26th, 9 a. m. | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 3 | |
| 28th, 9 a. m. | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 4 | { Faculae. |
| 28th, 5 p. m. | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | |
| 29th, 9 a. m. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | { Faculae. |
| 31st, 4 p. m. | 2 | 9 | 0 | 0 | ? | ? | 2 | 9 | |

*Approximated.

NOTES AND EXTRACTS.

Generation of Cyclones.—In an elaborate report upon the Madras Cyclone of May 1877, Mr. J. Eliot gives the following general conclusions relating to cyclone generation in the Bay of Bengal:

1. Cyclonic disturbances of small intensity are of frequent occurrence during the prevalence of the southwest monsoon or rainy season. Cyclones, or revolving storms of great extent and intensity, occur only at the two transitional periods, viz., at the April transitional period preceding the southwest monsoon, and the October transition period succeeding the southwest monsoon, and ushering in the north-east monsoon.

2. Cyclone occurrence is most probable during the October transition period.

3. The most intense and extensive cyclones occur during the October transition period.
4. The most powerful cyclones in the Bay tend to occur at or about the minimum sun-spot period.
5. Cyclones formed at the commencement of the April transition period, or near the end of the October transition period, are usually generated in the south of the Bay, and proceed towards the Coromandel coast.
6. Cyclones generated during the latter part of the April transition period, or the greater part of the October transition period (i. e., to the end of October,) usually take their origin in the centre of the Bay to the west or north-west of the Andamans, and advance towards the coast of Ganjam, Orissa or Bengal.
7. There is a strong antecedent probability, derived from past experience, of the occurrence of at least one intense cyclone at each minimum sun-spot period.
8. The invariable antecedents of powerful cyclones at the two transition periods are—approximate uniformity of pressure over and round the coast of the Bay of Bengal, light and variable winds or calms over a considerable portion of the Bay, and little or no rainfall over the coast region as well as in the Bay; the weather is hence sultry; the sea smooth. The amount of aqueous vapour accumulates, and finally gives rise to peculiar sky effects.* The immediate antecedent is heavy rainfall, concentrated over a portion of the Bay, accompanied by strong indraught, most marked from the Indian Ocean at the entrance of the Bay. This indraught from the Indian Ocean gives rise to strong winds and heavy rain at the stations on the south and west coasts of Ceylon.
9. The direction of progression of the cyclonic vortex when it is fully developed, varies according to the antecedent meteorological conditions of the Bay from west to north-east.
10. Cyclones at sea (i. e., cyclonic vortices) advance in approximately straight lines over the sea area.
11. The part of the coast struck by the cyclonic vortex is previously indicated as a rule (but not invariably) by a more rapid fall of the barometer than at the neighbouring coast stations.
12. The path of a cyclonic vortex at the two transitional periods appears to coincide closely, if not exactly, with the line of least atmospheric motion immediately previous to the origin and development of the cyclone.
13. The intense motion of a cyclonic vortex is confined almost entirely to the lower atmospheric strata. The plane of saturation is very probably at no great height. In no case has any cyclone of the Bay of Bengal crossed a mountain range. Deflection or destruction is the fate of a cyclonic vortex approaching the hills of the coast regions of the Bay. The only case on record of a cyclone crossing the peninsula of India is that of the 22nd October 1842, which passed by the Palghat Gap, and was traced to 60° E. longitude in the Arabian Sea.
14. In the discussion of cyclones the antecedent favourable conditions and the source of the energy must be carefully distinguished. The invariable and necessary antecedents are—
 - (1) Approximate uniformity of pressure over the Bay.
 - (2) Light and variable winds over the central area of the Bay.
 - (3) No general rainfall for some time previously over the Bay and in India.

The source of the energy is vapour condensation and rain precipitation, or, as stated in the Backergunge Cyclone Report, the primary cause of cyclone formation is "the production and ascent of a large quantity of vapour which is condensed with the liberation of its latent heat over the place of its production instead of being carried away to some distant region."
15. The air motion in cyclones is one of indraught, and therefore the wind direction at any point is not at right angles to the direction of the centre. The stream lines or the lines of air motion are spiral curves. The relation between the wind direction and the direction of the centre is probably not invariable, but depends upon the intensity of the storm or the baric gradient. The law laid down by Mr. Willson in the Report on the Midnapore Cyclone is probably the nearest approximation. It is "with the face of the wind, the direction of the centre is from ten to eleven point to the right hand side."

*The most complete account of these will be found in a small poetical description of the cyclones of the Bay of Bengal, published by J. R. Elson, Esq., Master Pilot, Calcutta.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Meyer

Brig. Gen. (Bvt. Assg'd.) Chief Signal Officer, U. S. A.

Copy furnished for

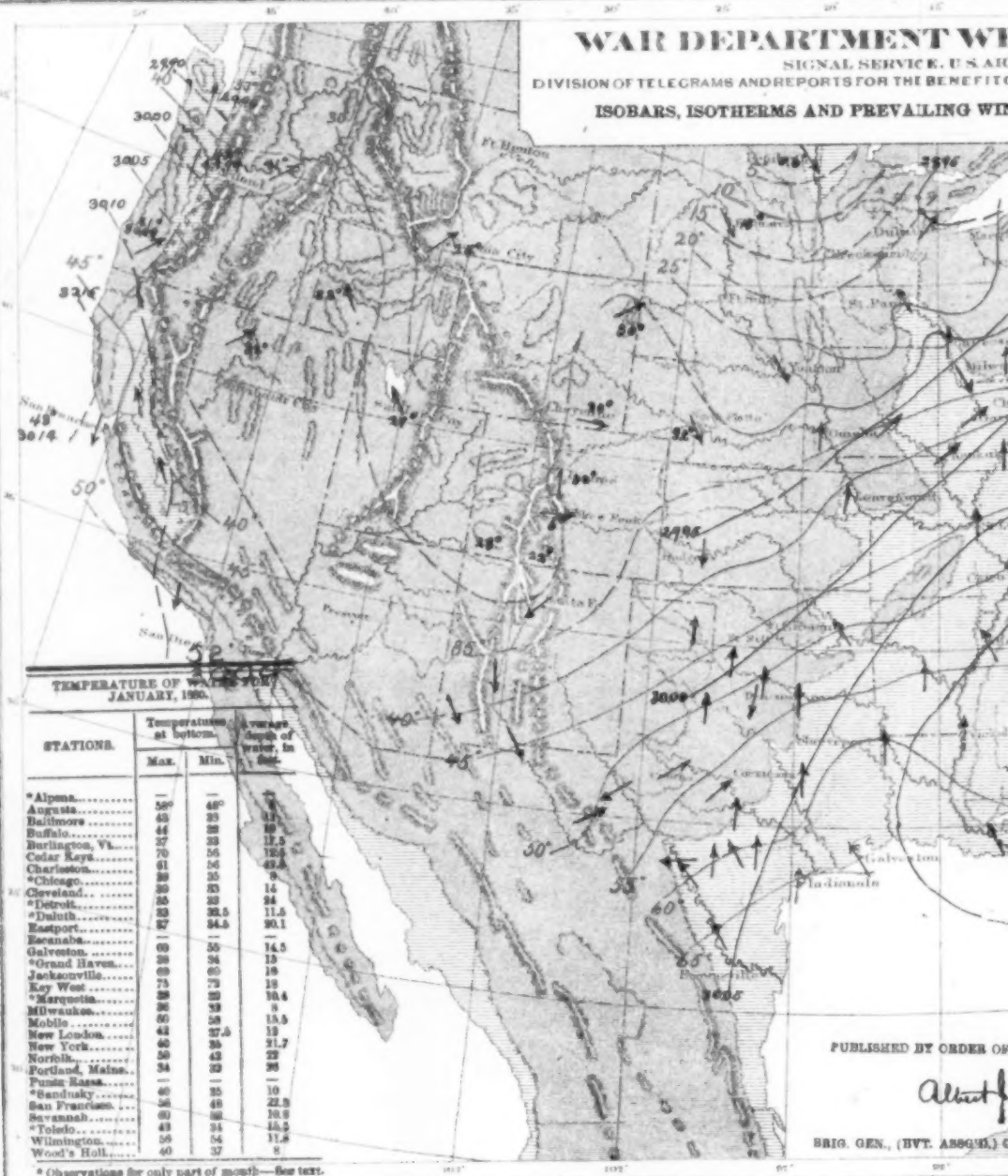




WAR DEPARTMENT

SIGNAL SERVICE, U.S.A.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF

ISOBARS, ISOTHERMS AND PREVAILING WINDS

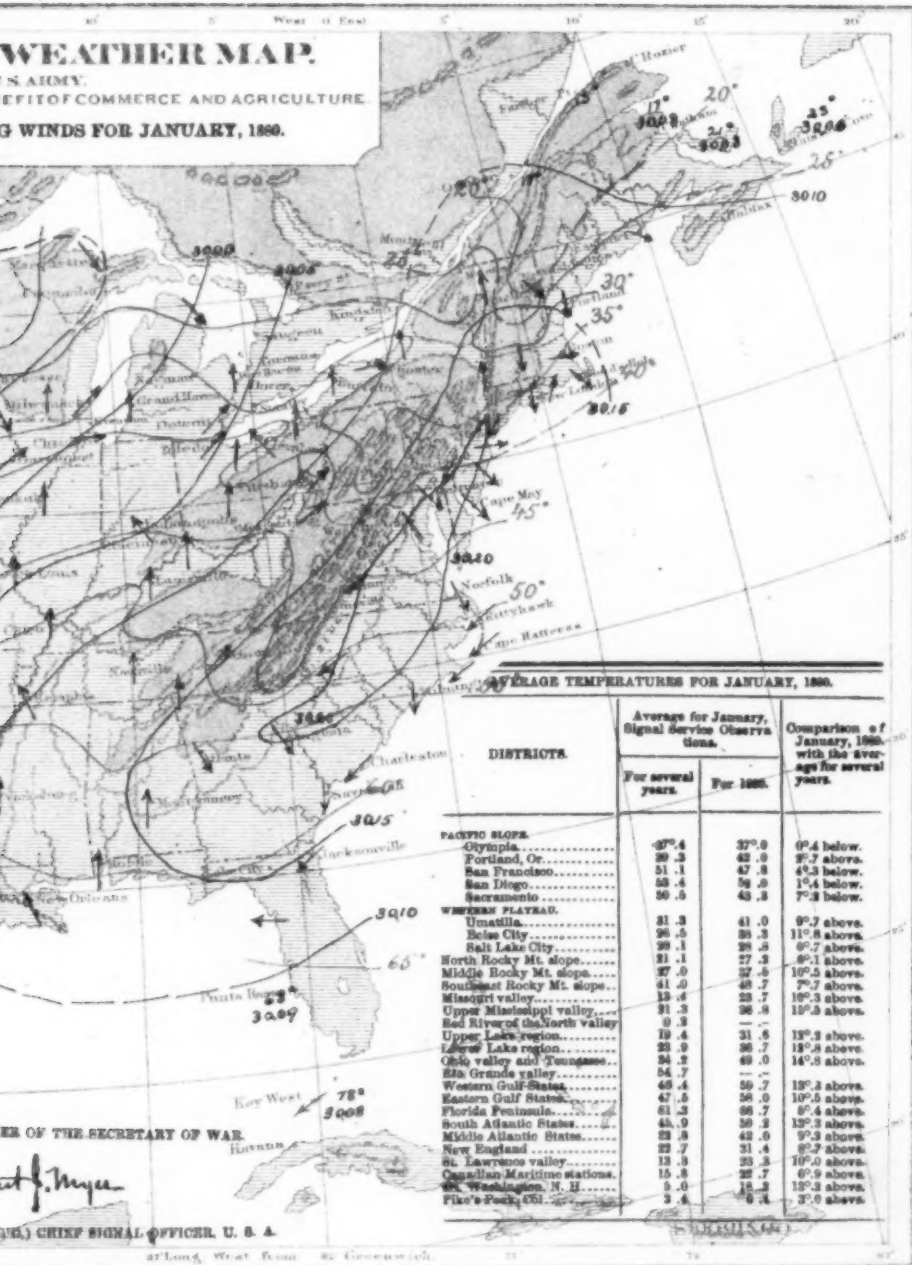


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WEATHER MAP.

U. S. ARMY.
DEPT. OF COMMERCE AND AGRICULTURE
WINDS FOR JANUARY, 1880.



BY ORDER OF THE SECRETARY OF WAR.
J. M. Myers
CHIEF SIGNAL OFFICER, U. S. A.

| AVERAGE PRECIPITATION FOR JANUARY. | | | |
|------------------------------------|----------------------|-----------|---|
| DISTRICTS. | Average for January. | | Comparison of January, 1901, with the average for many years. |
| | For many years. | For 1901. | |
| | Inches. | Inches. | Inches. |
| St. Lawrence Valley..... | 2.23 | 2.26 | 0.03 excess. |
| New England..... | 3.70 | 3.78 | 0.08 deficiency. |
| Middle Atlantic States..... | 3.31 | 3.07 | 1.24 deficiency. |
| South Atlantic States..... | 3.69 | 3.05 | 0.64 deficiency. |
| Florida Peninsula..... | 4.49 | 2.53 | 3.95 deficiency. |
| Eastern Gulf States..... | 3.73 | 1.58 | 4.19 deficiency. |
| Western Gulf States..... | 5.02 | 4.78 | 0.24 excess. |
| Tennessee..... | 3.50 | 3.35 | 0.15 deficiency. |
| Ohio Valley..... | 3.37 | 3.33 | 0.04 deficiency. |
| Lower Lake Region..... | 1.84 | 2.60 | 1.04 excess. |
| Upper Lake Region..... | 1.51 | 2.40 | 0.89 excess. |
| Upper Mississippi Valley..... | 0.60 | 0.75 | 0.15 excess. |
| Minnesota..... | 1.00 | 3.24 | 2.24 excess. |
| Lower Missouri Valley..... | 1.51 | 0.46 | 1.05 deficiency. |
| Upper Missouri Valley..... | 3.87 | 1.12 | 2.75 deficiency. |
| California Coast..... | 6.00 | 13.37 | 6.37 excess. |
| Portland, Or..... | 6.97 | | |

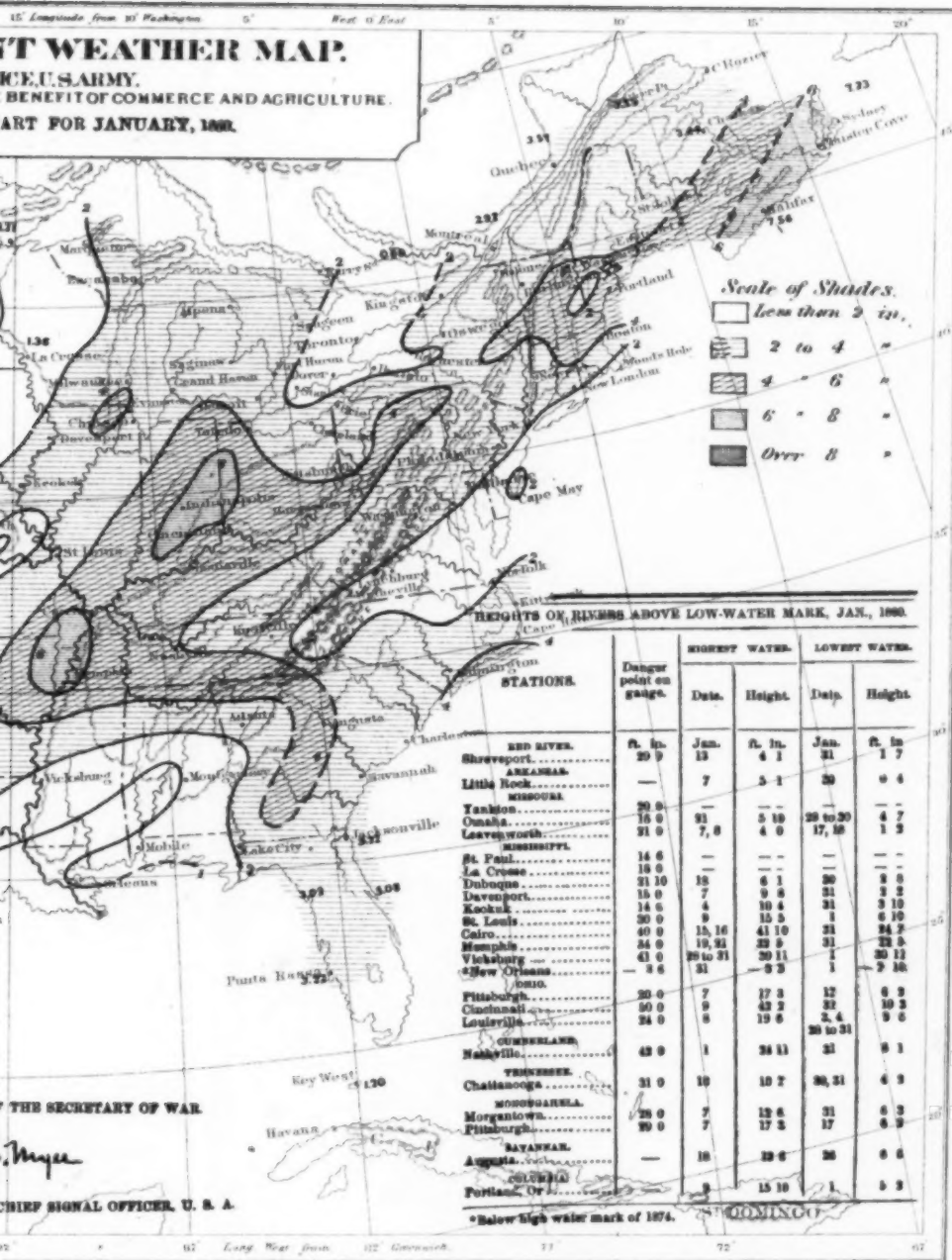


CHART No. IV.

WINDS ACCOMPANYING THE ATLANTIC STORMS.

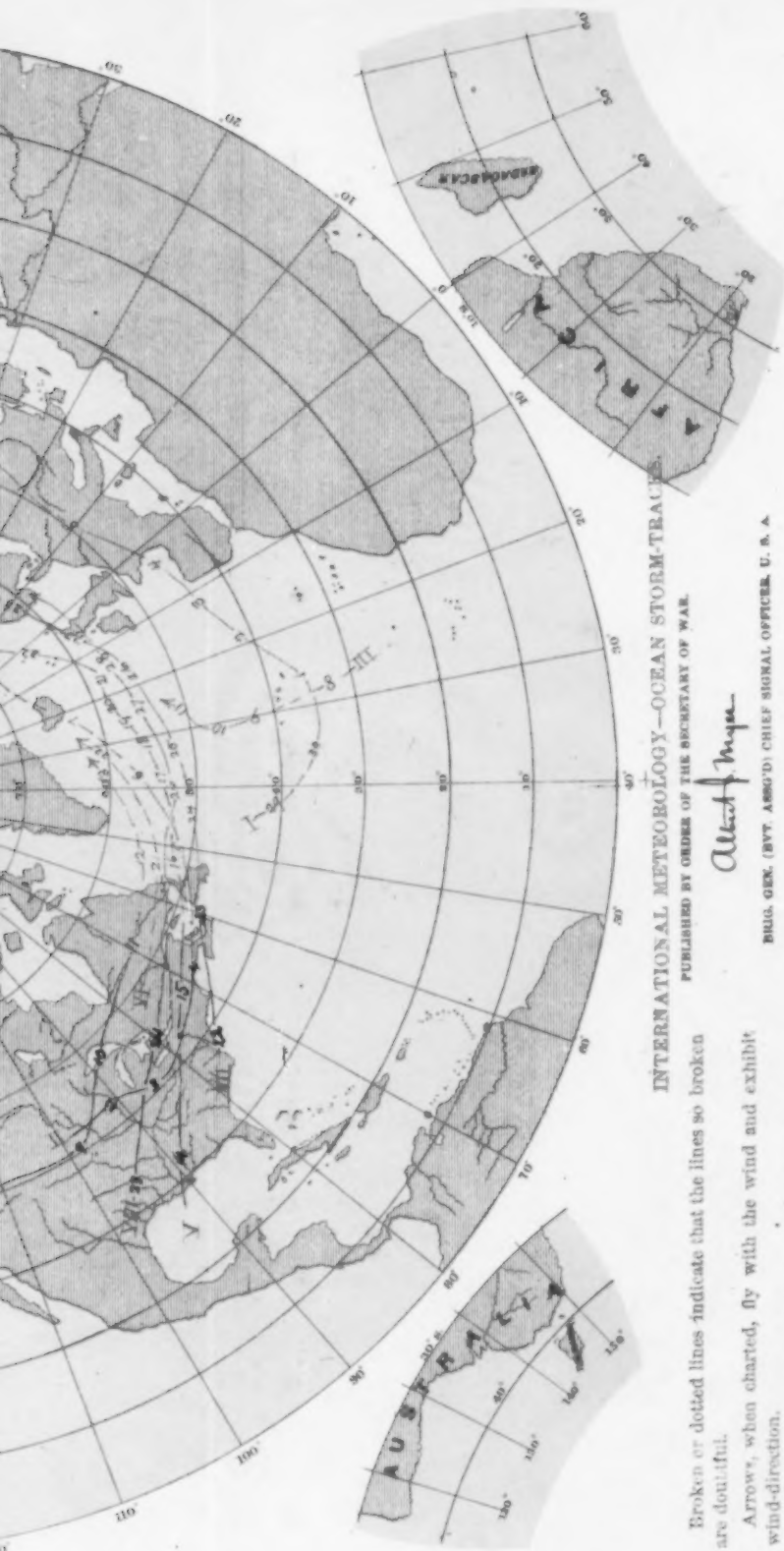
| No. | American Coast. | | | | European Coast. | | | |
|-------|-----------------|-----------------|-----------------|-------------------|-----------------|------------|-----------------|-------------------|
| | Date. | Direction. | Miles per Hour. | Miles per Second. | Date. | Direction. | Miles per Hour. | Miles per Second. |
| II. | Dec. 4. | Southerly. | 20 | 13.4 | Dec. 6 & 8. | S.W. | 20 to 30* | 12.8 to 16.3 |
| V. | 15 | East. | 35 | 21.9 | 21 | S.E. | 40 to 50* | 17.9 to 22.9 |
| VII. | 22 | North-easterly. | 40 | 25.8 | 22 | S.W. | 50 to 60* | 22.9 to 27.8 |
| VIII. | 23 | S.W. & E. | 30 | 19.3 | 23 | S.W. | 50 to 60* | 22.9 to 27.8 |

* Estimated from a scale of 0 to 8.

INDEX TO STORM-TRACKS.

| Atlantic Ocean. | |
|-----------------|------------------------------------|
| No. | From Nov. 25th to Dec. 7th, 1879. |
| I. | From Dec. 2nd to Dec. 13th, 1879. |
| II. | From Dec. 4th to Dec. 11th, 1879. |
| III. | From Dec. 13th to Dec. 20th, 1879. |
| IV. | From Dec. 21st to Dec. 28th, 1879. |
| V. | From Dec. 29th to Dec. 31st, 1879. |
| VI. | From Dec. 1st to Dec. 2nd, 1880. |
| VII. | From Dec. 3rd to Dec. 4th, 1880. |
| VIII. | From Dec. 5th to Dec. 6th, 1880. |





INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS. PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

A. A. M. J. M.

BRIG. GEN. (BVT. ARMY) CHIEF SIGNAL OFFICER, U. S. A.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous issues.

The tracks charted in red have been made from data collected since preceding Review.

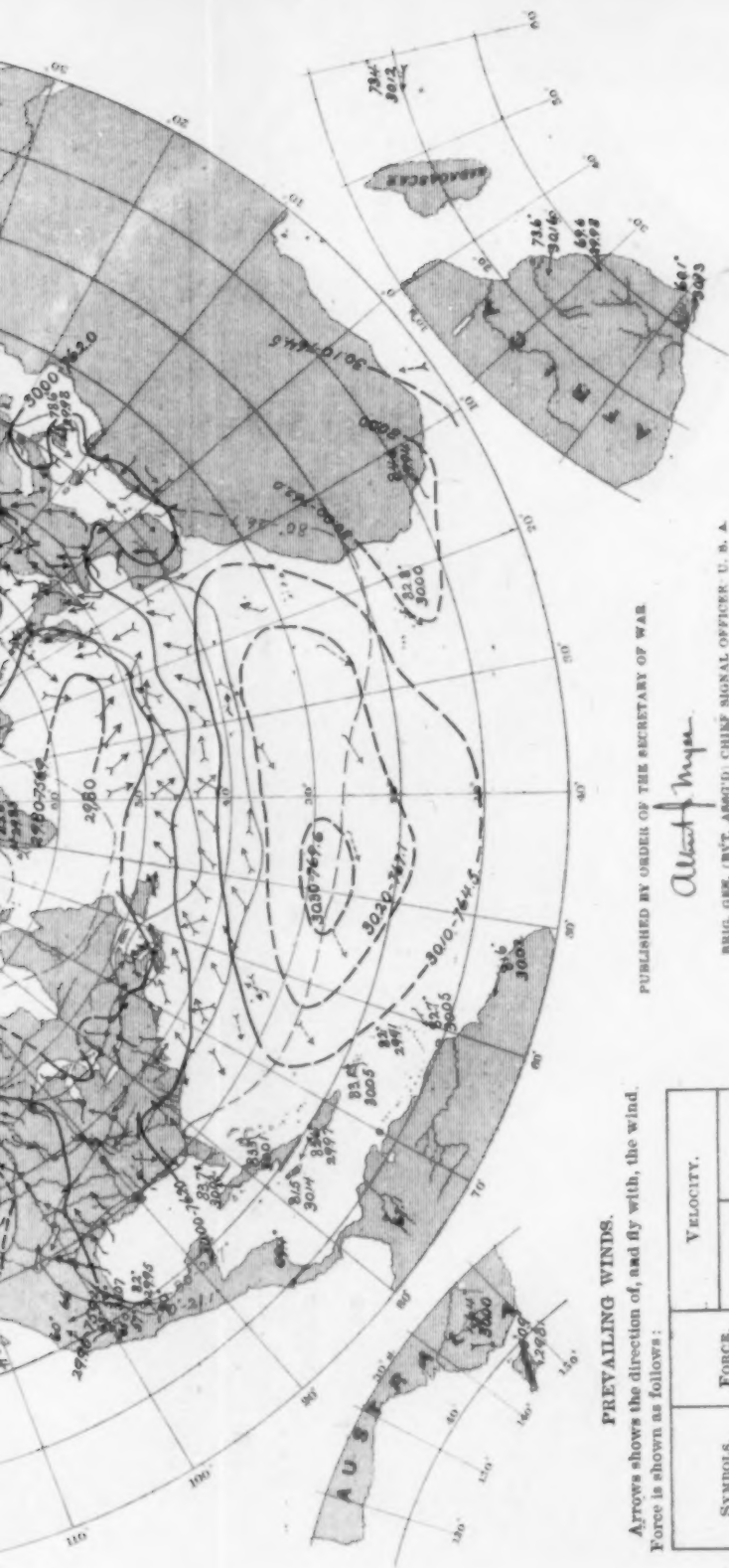
No. V.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing October, 1877.










PUBLISHED BY ORDER OF THE SECRETARY OF WAR

Albert Meyer.

PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind.
Force is shown as follows:

| SYMBOLS. | FORCE. | VELOCITY. | |
|---|--------|-----------------|--------------------|
| | | Miles per hour. | Metres per second. |
|  | 1, 2 | 0 to 9 | 0 to 4.0 |
|  | 3, 4 | 9.1 to 22.5 | 4.1 to 10.1 |
|  | 5, 6 | 22.6 to 40.5 | 10.1 to 18.1 |
|  | 7, 8 | 40.6 to 67.5 | 18.1 to 30.2 |
|  | 9, 10 | 67.6 up. | 30.2 & over. |

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.
Isotherms in *red*; detached temperature means in degrees Fahrenheit.

INTERNATIONAL MONTHLY CHART.

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of June, 1878, based on the daily charts of the International Bulletin.

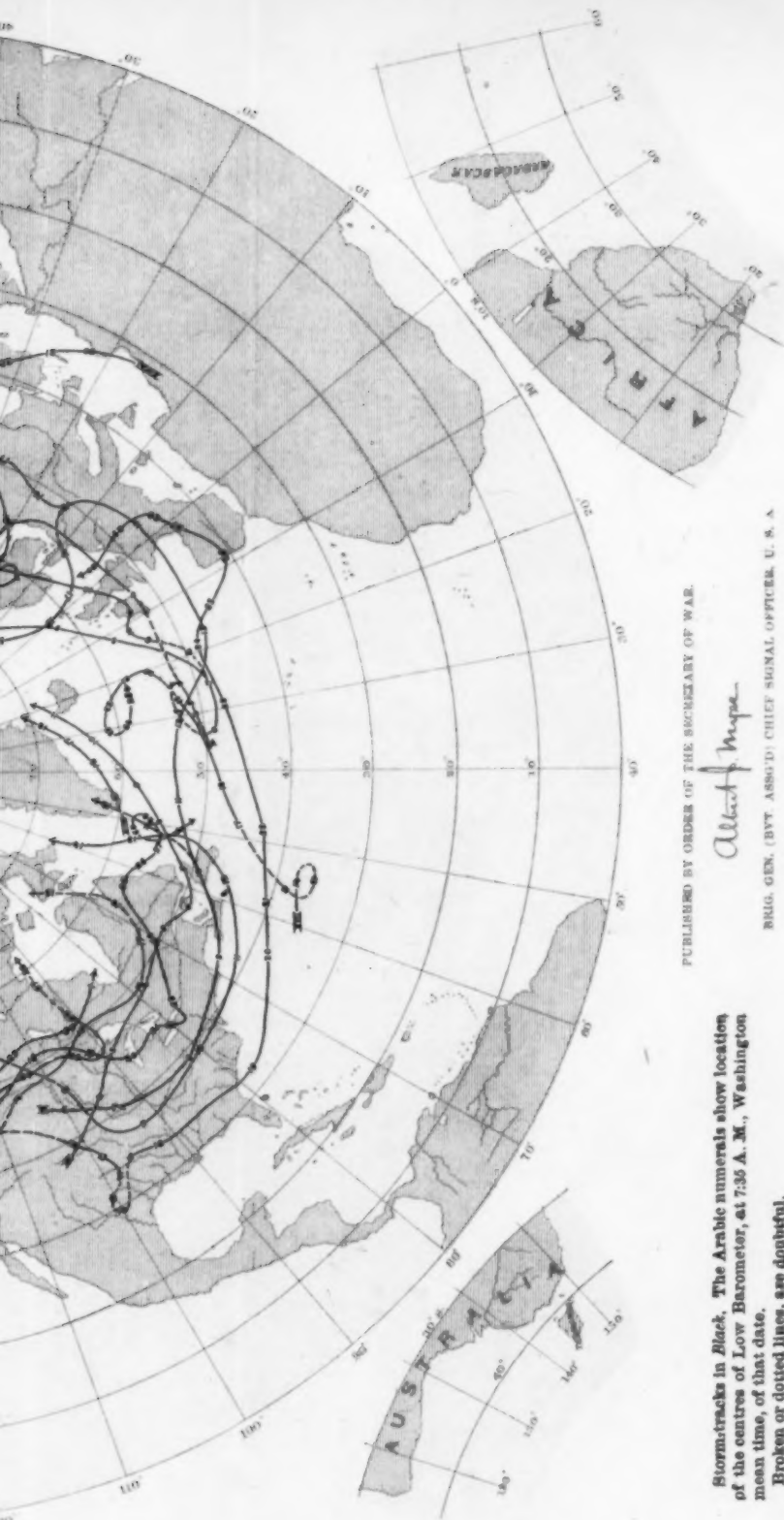
Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing October, 1877.

No. VI.





PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert Myer

BRIG. GEN. (BYT. ASSO'D) CHIEF SIGNAL OFFICER U. S. A.

Storm-tracks in Black. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

INTERNATIONAL CHART.
Showing Tracks of Centres of Low Barometer for
June, 1878.